HEATING & VENTILATING
AIR CONDITIONING

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FOR OCTOBER, 1936

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For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning.

ANNOUNCING—"A YEAR OF PROGRESS"—SPECIAL JANUARY, 1937, ISSUE

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HEATING & VENTILATING is published monthly by The Industrial Press, Robert B. Luchars, President; Edgar A. Becker, Vice-President and Treasurer; Erik Oberg, Secretary. Published at 148 Lafayette Street, New York, N. Y. Western Office, 228 North La Salle Street, Chicago, Ill. Yearly subscription in United States and Mexico, $2.00; in Canada, $2.50; in all other countries, $3.00. Single copies, 30 cents. Member of Audit Bureau of Circulation and Associated Business Papers.

VOLUME 33 NUMBER 10

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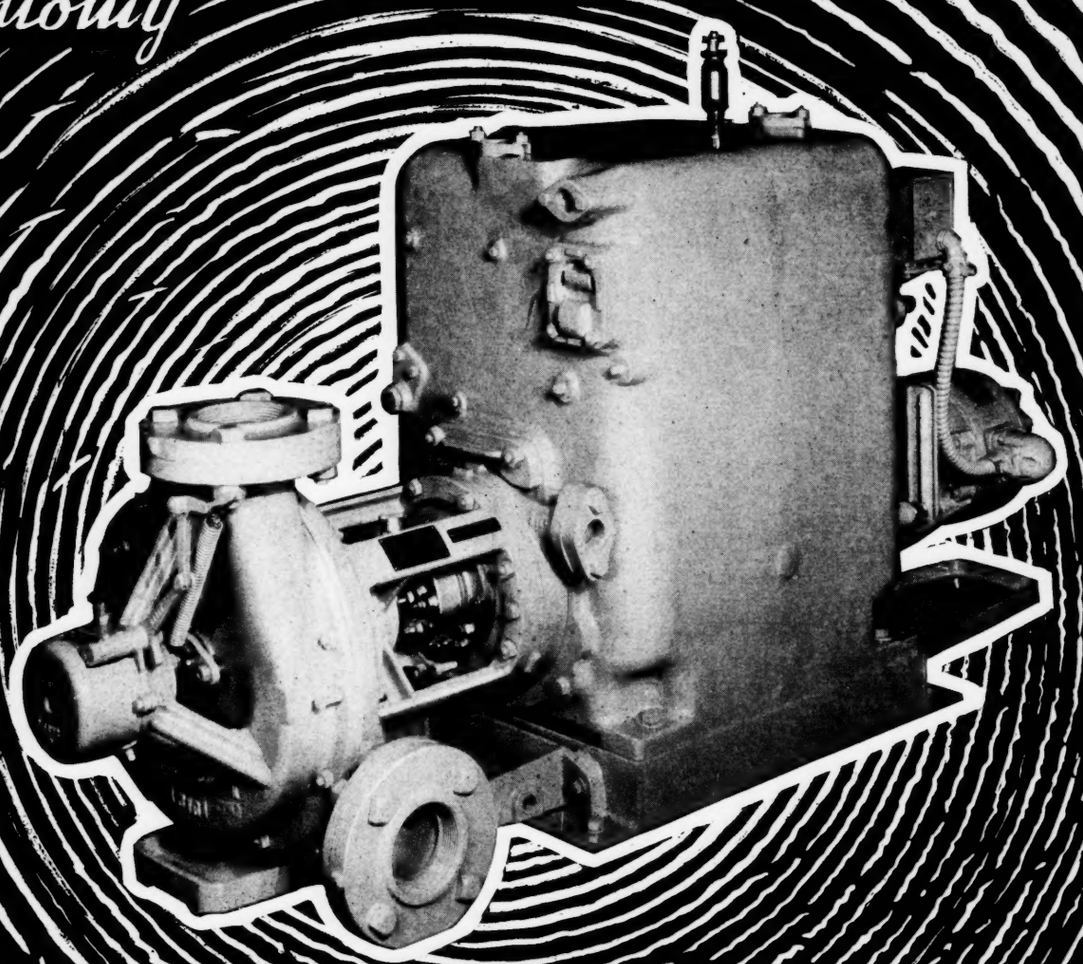

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ADDRESS

District Heating Power Station of the Federal Technical University, Zurich

By R. RUEGG†

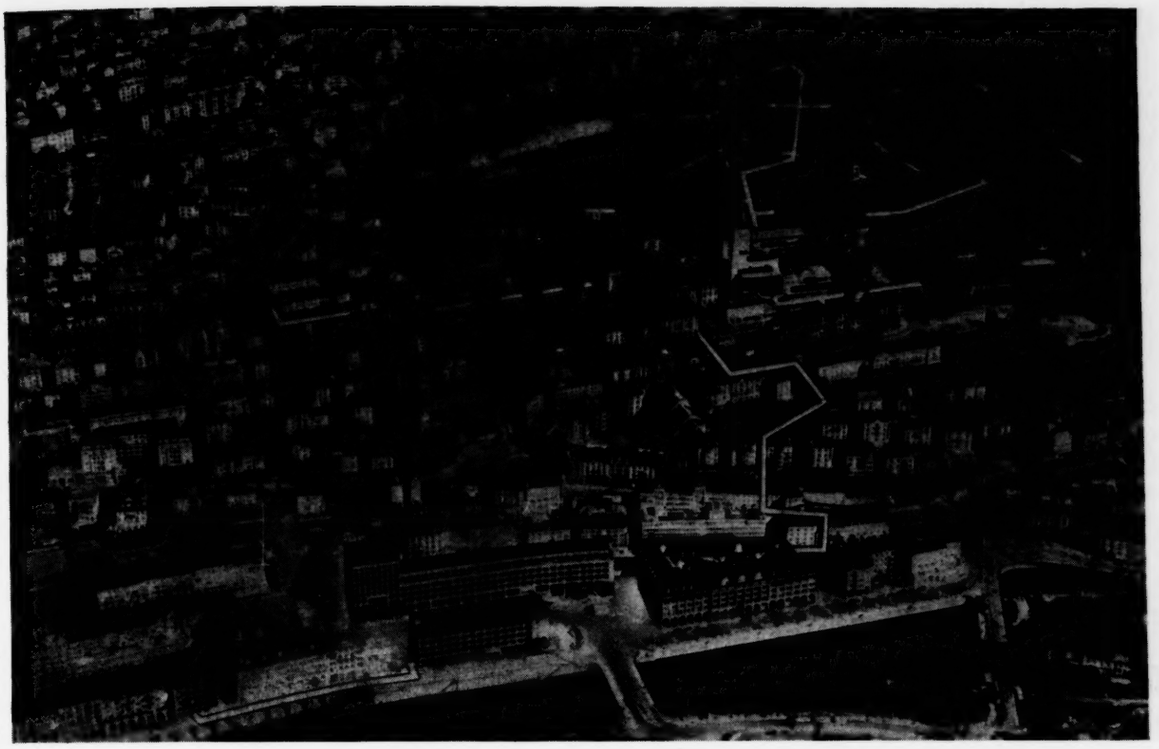


Fig. 1. Airplane view of the buildings heated by the district heating power plant.

WHEN the engineering laboratory was first established in 1899, erection of a central boiler house for supplying hot water to all the buildings of the Federal Technical University was taken into consideration. At that time, however, the scheme had to be abandoned because of the lack of sufficient experience. It was brought up again only when it proved necessary to acquire new heating plants for several buildings at nearly the same time. It was due to the efforts of the president of the Swiss Educational Council, Prof. A. Rohn, that the project for the erection of a district heating power station and the extension of the engineering laboratory, which had to a certain extent been studied also by Professor Stodola, was brought to a successful conclusion and agreed upon by the Federal authorities. The scheme in its first form considered only the erection of a district heating station, but also contained full provision for later development into a district heating power station.

The old engineering laboratory had become out of date because of the rapid advance in engineering science and an extension of the building and a renewal of the engineering equipment had long been seen to be absolutely necessary. It was clearly desirable to bring the district heating station and the engineering laboratory together in one building, since the heating station was intended to be an important subject of demonstration and research for the students of the University. As there was no question of adopting anything else but steam turbines for the new machinery equipment, it was decided to extend the heating station into a heating power station, both because of the requirements of the University and to obtain the advantages of a district heating power station. Fig. 1 shows the site of buildings heated by the district heating power station.

Fig. 2 is a ground plan showing the engineering laboratory and the district heating power station. An endeavour was made to keep the engineering laboratory and the district heating power station separate as far as possible. The district heating power station occupies the northern part of the group of buildings, in the northwest corner of which is situated the boiler house with coal bunkers and concrete chimney. Next to the boiler house is the engine room with the heating station, the turbo generating sets, and the other laboratory machines. The lecture rooms and classrooms are situated between the street and the engine hall, which is bounded on the northeast by the locality containing the switchgear. Fig. 3 gives a section through the plant, from which the position of the high-voltage room in the second basement can be seen. The laboratories for electrical engineering and small internal combustion engines are situated in the basements below the class-

†Sulzer Brothers Limited, Winterthur, Switzerland.

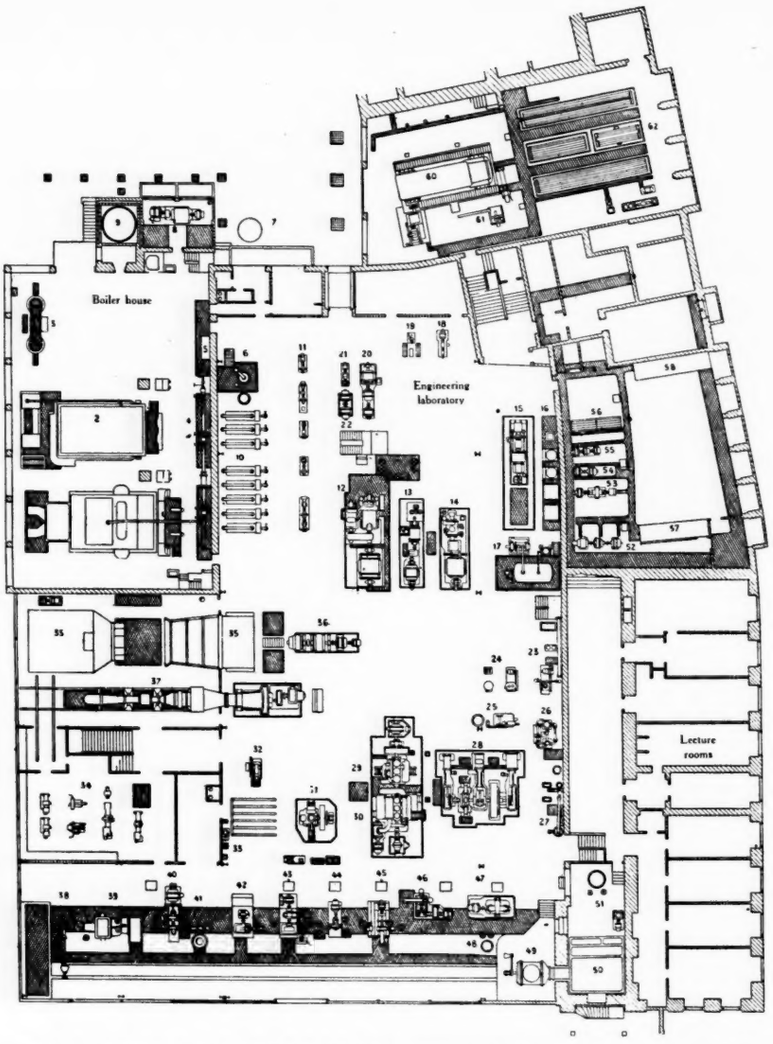


Fig. 2. Plan of the district heating power station and of the engineering laboratory of the Technical University, Zurich.

rooms. The arrangement of the other laboratories can be seen from Fig. 2, except the textile laboratory, which is located over the workshop.

The district heating power station, in addition to its essential purpose as a supplier of heat and electric current, serves as an object of study for the engineering students. This is the point to which particular attention must be paid, since in choosing the machines and apparatus and their technical qualities, overall efficiency was not the primary consideration; in many cases, more consideration was paid to the fact that the district heating power station would be used for the purpose of research. From this point of view above all is to be attributed the choice of a high-pressure steam plant and also the installation of numerous measuring instruments.

Transportation of Fuel

In planning the installation, particular attention was devoted to the transport of fuel. Since the daily fuel consumption in winter amounts to 20 tons and possibly more, it appeared at first that a large fleet of motor lorries would be absolutely essential. However, the circumstance that the Letten tunnel of the Swiss Federal Railways run directly underneath the district heating power station, gave the possibility of obtaining direct connection to the railway through a shaft, thereby relieving the streets, in which the traffic is already very congested. The pneumatic coal conveying plant which has been installed, allows 60 tons of coal to be unloaded from the railway trucks and raised over 130 ft. during the night, between midnight and 4 o'clock in the morning when there is no traffic on the railway. The coal separates from the air in a container, from where it passes through a "lock" into the compensating bunker. Afterwards the coal is passed by a bucket conveyor into the silos. After the air from the separating containers has had the greater part of the dust removed from it by filters, it passes to a suction draft blower and then to the stoker under the boiler, so that the coal is consumed right to the last particle of dust. From the silos the coal is led through automatic weighing machines to the stokers of the boilers.

Boiler Plant Equipment

At present the following steam generators are installed in the boiler house:

1—A 35-atmos., two-drum, double-bank boiler with overfeed firing, raising 18 tons of steam per hour, fitted with additional oil firing, and with air heater, economizer, forced draft fan, suction draft and soot blowing plants. Fig. 4 shows the upper part of this boiler.

2—A 100-atmos., high-pressure, single-tube steam generator with zoned travelling stoker and additional oil firing, also for raising 18 tons of steam per hour, fitted with air heater, economizer, forced draft fan, suction draft and soot blowing plants, and an automatic regulating station.

Normally, one boiler is sufficient to supply the heat required for generating current and for heating purposes. When the outside temperature is low, the two boilers are put into operation, the high-pressure boiler

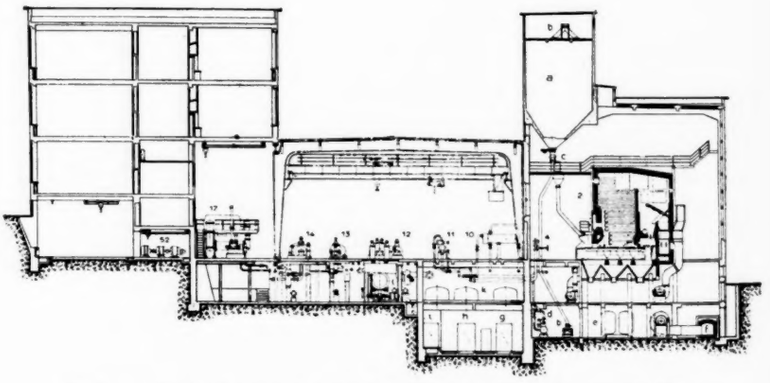


Fig. 3. Section through the district heating power station and engineering laboratory.

then taking the main load, while the upright two-drum boiler has to cover the peaks.

The boiler plant is equipped with an automatic steam pressure reducing station, which keeps the pressures in the various steam systems constant when the turbo-electric set is not running.

3—Two electrode boilers for raising saturated steam at 10 atmos. Several of the buildings, particularly the hospital, require an uninterrupted supply of a smaller quantity of heat in the form of steam and hot water also during the summer months. This heat is supplied by the electric boilers, for which current can be obtained at a price which makes their working no more expensive than when using coal. The combination with the oil-fired or coal-fired boilers that take over the service in winter, shows the economical possibilities for the cooperation of thermal and hydroelectric sources of energy in Switzerland.

Electric Generating Equipment

The steam at 100-atmos. pressure passes first through a primary turbine and then into the 35-atmos. system, in which a back-pressure extraction turbine and a condensing turbine with double extraction are included. These turbines supply extracted steam both to the 10-atmos. and to the 1-atmos. systems. The existing steam heating installations in the hospital and in the chemical laboratory are served directly from the 10-atmos. system.

The steam at 1 atmos. serves for heating the hot water in the counter-current apparatus, and also for supplying service water.

An interesting detail in connection with the double extraction condensing turbine is the arrangement of the set, the two casings of the turbine being arranged parallel to each other. The low-pressure part is connected direct to the generator, while the high-speed, high-pressure part drives the generator through a toothed gear with three shafts. Consequently, it is possible to put one half or other of the turbine out of operation. The coupling is arranged in such a manner that the gear is at rest when the high-pressure part is shut down.

The valve gear of the turbo set takes account of these different possibilities of working and allows the following operating methods to be used, regulated by the steam pressure:

1—The high-pressure part runs as back-pressure extraction turbine, while the low-pressure part works as an independently governed condensing turbine. The quantity of live steam consequently fluctuates with the demand for heat.

2—With the actual double extraction condensing service, the quantity of live steam is kept constant. The steam not required for heating is taken by the low-pressure part.

3—With the low-pressure part shut down, the set can work as a normal back-pressure extraction turbine.

4—With the high-pressure part shut down, the low-pressure turbine works as a pure condensing turbine.

In order to be independent within certain limits of the demand for heat when generating electric energy, and to be able to supply the energy according to a definite program, a condensing turbine was provided,

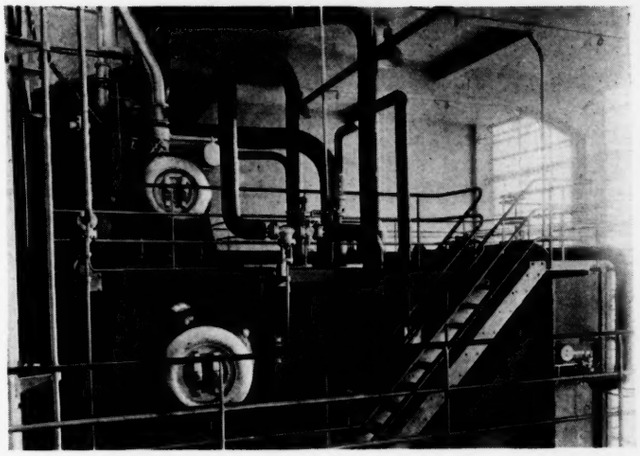


Fig. 4. Two-drum, double-bank boiler with overfeed firing.

for which considerable quantities of cooling water are required. A cooling plant for the water, therefore, also had to be provided. The cooling tower, together with the chimney, forms the characteristic tower for the district heating power station here described.

Particular attention was paid to the treatment of the feed water. The make-up water, which is of about 18° German hardness, is taken from the municipal supply, and is first of all softened chemically. But since the water thus treated still contains a considerable quantity of sodium-bicarbonate, all the make-up water is distilled. The make-up water, along with any condensate, is also deaerated before being led to the boilers.

Building Heating

Most of the buildings are heated by hot water. The water is heated in counter-current apparatus installed immediately beside the hot water circulating pumps. Great value was attributed to a symmetrical arrangement of the apparatus and pumps. As far as possible the pipes are led in the basement, where the auxiliary apparatus, such as steam traps, coolers, and water measuring apparatus, are also located.

The heating mains are laid in ducts, the more important of which are designed as passages.

The electric switch gear of the district heating power station comprises the electric equipment required for the exchange of electric energy between the district heating power station and the municipal electricity works in Zurich, and also for distributing energy for the auxiliary services in the district heating power station and the various laboratories. This power station is connected to the municipal electricity works of Zurich by two 6,000-volt cables. The 6,000-volt switch gear has four sets of busbars, the switches to which are operated by remote control from the central control room.

The electric and thermal measuring instruments are also located in the central control room.

As already mentioned, the equipment of the central heating station is intended to be used, in addition to its actual purpose, as a valuable object of research for carrying out tests without interfering with the working of the service.

The district heating power station, which was built

under the supervision of Prof. H. Quiby and Dr. B. Bauer, is at present supervised independently as a separate annex of the Federal Technical University. It serves a considerable district; in addition to the Federal and Cantonal buildings, many private houses are already also connected, and this contributes to a large extent to give an economical load and allow for effective utilization of the existing plants.

New schemes for extending the district served are at present under consideration, so that it can be assumed that the district heating power station will soon be fitted with several different means of transmitting heat for central heating plant and technical requirements, and thus allow considerable experience being gained which will be valuable in solving questions concerning municipal district heating.

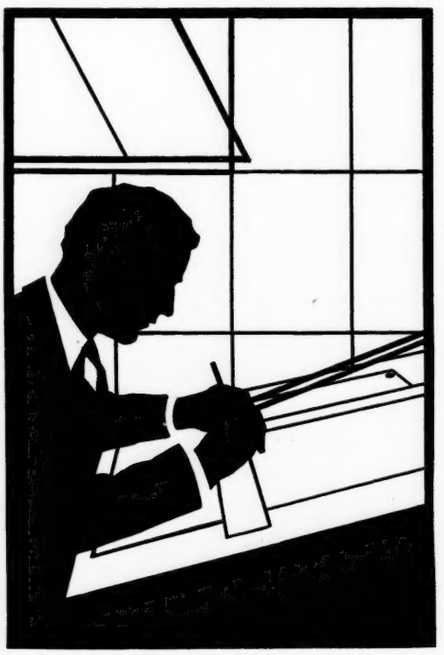
Symbols for Drawings of Mechanical Equipment for Buildings

THE accompanying four tables present in compact form what is believed to represent current practice in the use of symbols for indicating various types of heating, refrigeration, piping, plumbing, and electrical equipment, as well as for conventional section lining of materials.

It is highly desirable that, wherever possible, draftsmen use the same symbols to represent the same thing; otherwise there is considerable confusion, in some cases resulting in delay of a costly project. Many draftsmen make a practice of using, for example, simple full lined cross-hatching to represent sections of all materials but adjacent to it letter the name of the material. Use of different kinds of cross-hatching is probably better practice, since it is not infrequent that the draftsman may forget to add the name of the material, and if the cross-hatching is standardized the user of the drawing often has no need of additional lettering.

While the need for standardized symbols has been well recognized, it is not always simple to obtain an agreement as to the particular form a given symbol should take. This seems to be especially true in the electrical field, where some of the basic symbols have not as yet been agreed upon.

In order, however, to give engineers engaged in heating, ventilating and air conditioning work a set of standard symbols, the accompanying four tables are presented. Table 1 covers three different types of symbols, the first two on heating and ventilating and on piping being those recently adopted by the American Standards Association and published as "American Standard Drawings and Drafting Room Practice-Graphical Symbols" (ASA-Z14.2-1935). They are the result of the work of a sectional committee on standards for drawings and drafting room practice which was organized in 1926 with six sub-committees, and the symbols in the first two sections of Table 1 are the result of work by sub-committee six. They received approval by the sponsor organizations in November, 1935, and were designated as an American standard by ASA at that time. Cooperating in the adoption of these standards were, among others, the American Society of Heating and Ventilating Engineers, American Society of Mechanical Engineers, and the Heating, Piping and Air Conditioning Contractors National Association.



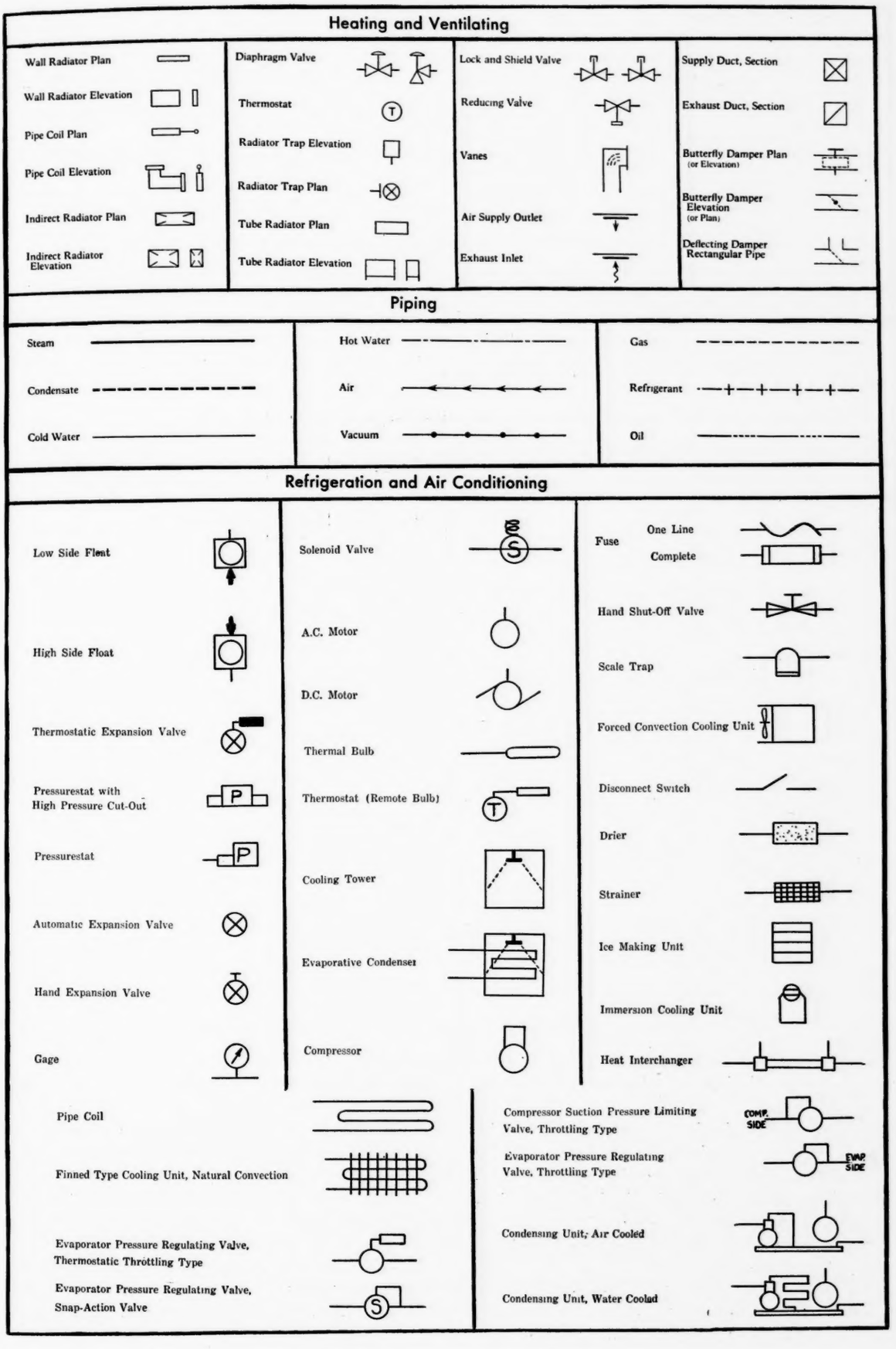
The symbols on refrigeration and air conditioning equipment making up section three of Table 1 are those adopted in August, 1936, by the refrigeration division of the National Electric Manufacturers Association, Refrigerating Machinery Association, and the Air Conditioning Manufacturers Association. During August they were submitted to members of these associations as "recommended practice" in connection with blueprint and drafting work. They are not claimed to be complete or final, according to the associations in a joint statement, but may be added to from time to time as desirability indicates.

Table 2, giving the standards for pipe and pipe fittings, is also taken from the ASA-Z14.2 standards, as are the first and second sections of Table 3, giving symbols for heat-power drawings and for plumbing equipment.

Section three of Table 3, recommended practice for sectional cross-hatching and for outside views of materials as well, are ASA Recommended Practice for Drawings and Drafting Rooms (ASA-Z-14.1-1935). These standards are largely devoted to machine drawings and general drafting room practice, the part on cross-sections being probably the only important material dealing with general drafting room practice which is of specific interest to heating and ventilating engineers.

Table 4 includes the oldest of the standards included here. They are the standard symbols for electrical equipment of buildings as adopted by the American Insti-

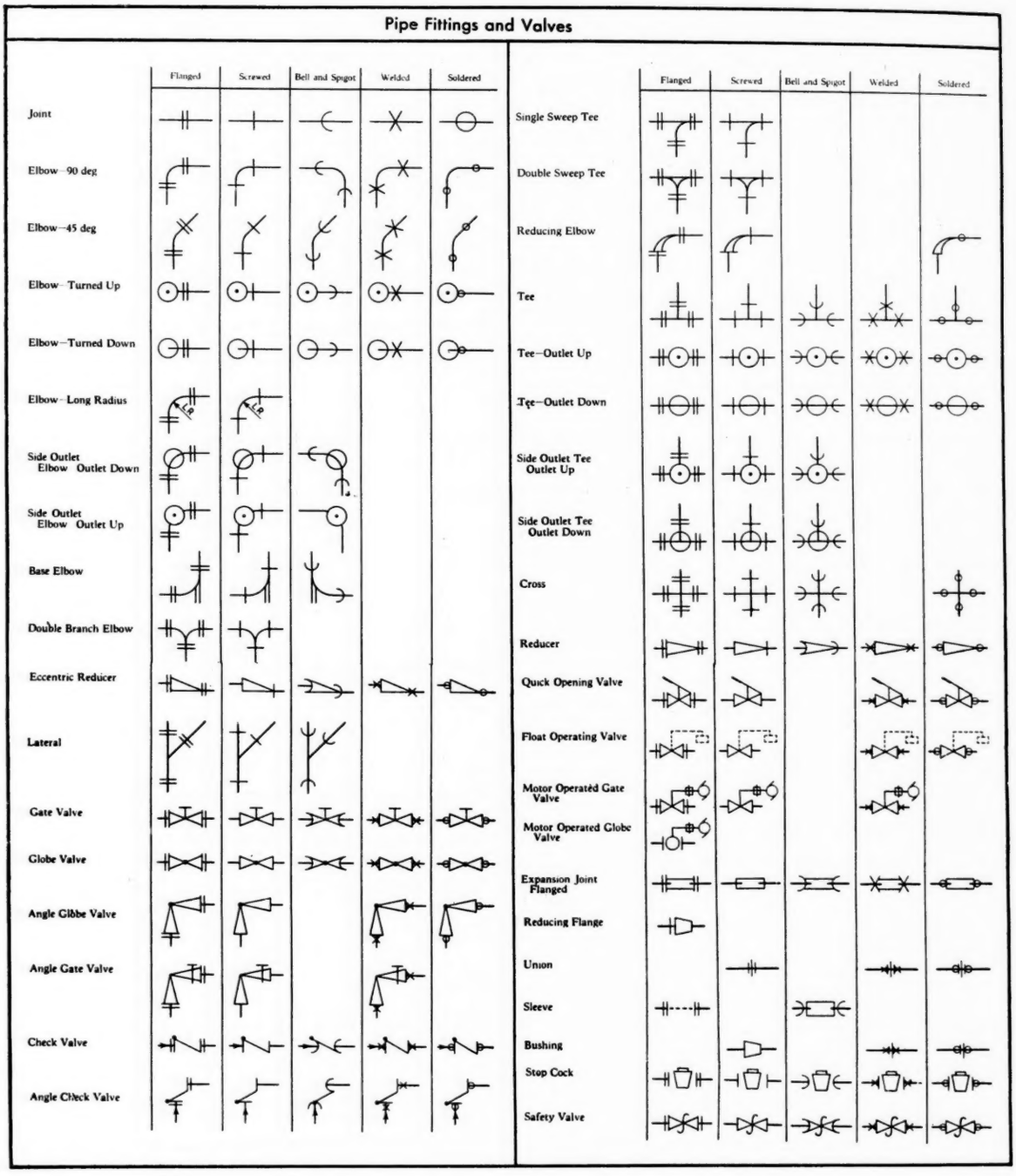
TABLE 1



tute of Electrical Engineers in December, 1923, and which were adopted as part of the ASA standard the following year (ASA-C-10-1924). Sponsors of these standards were the AIEE, American Institute of

TABLE 2

Pipe Fittings and Valves



Architects, and Association of Electragists-International.

In connection with standards on symbols it should be mentioned that the ASA has issued in its Standards for Drawings and Drafting Room Practice recommendations for lettering. According to the ASA the most important requirement for lettering as used on working drawings is legibility, the second is ease and rapidity of execution. These two requirements are met in the single stroke commercial gothic letter, now in almost universal use throughout the technical world. Preference seems to be divided between the vertical and the inclined styles.

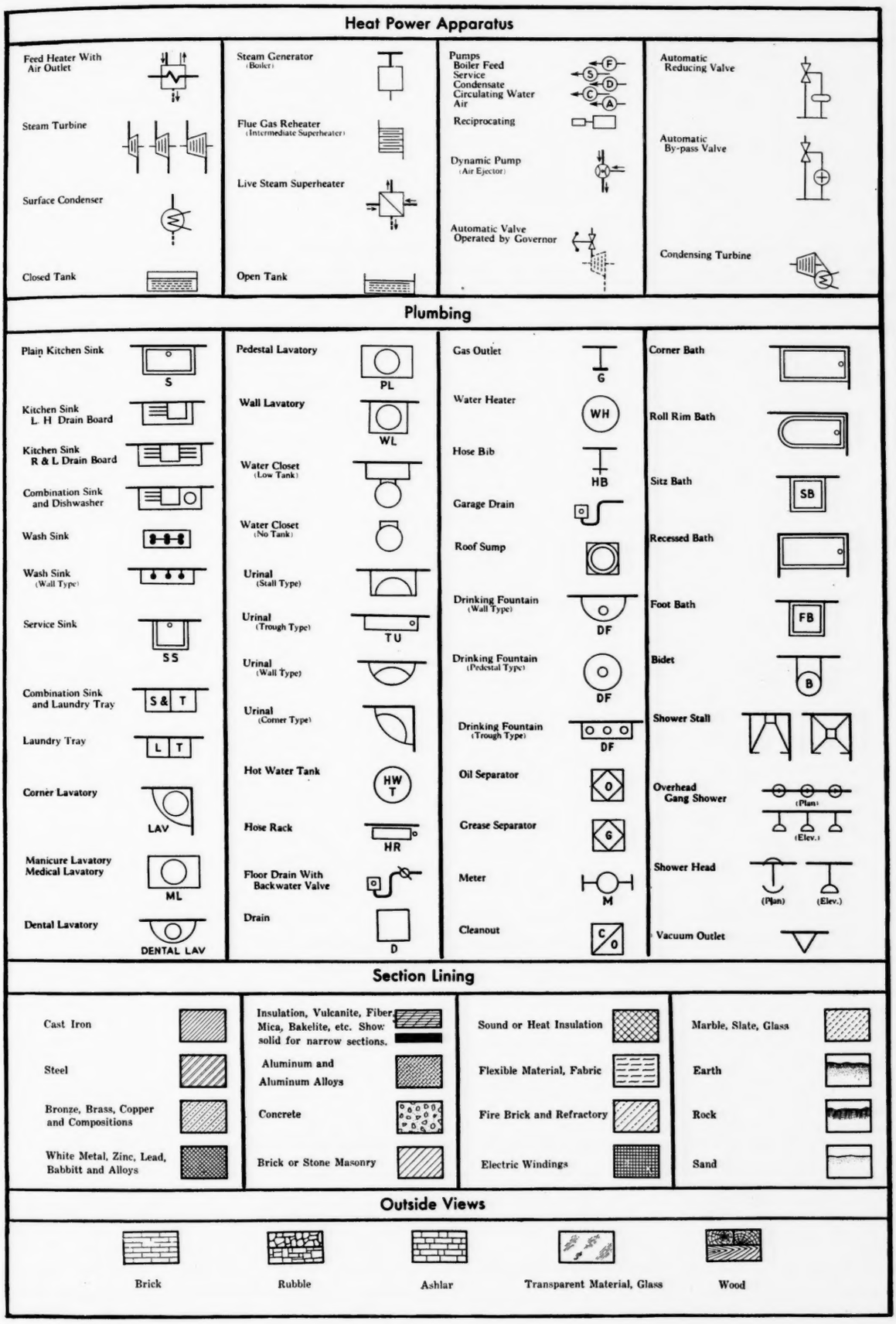
The following standard practice is recommended: A—That single stroke commercial gothic letter either vertical or inclined at a slope of 2 in 5 be used on all working drawings for titles, notes, etc.; B—that only capitals be used in the title box; C—that for notes, bills of materials, etc., if the vertical style is chosen the letters should be all caps. If the inclined style is chosen the letters may be all caps or caps and lower case.

It is not desirable to grade the size of lettering with the size of the drawings except when a reduced photographic reproduction of the drawing is to be made. In other words, the size and weight of the lettering should be such as will produce legible prints from tracings either in pencil or in ink.

Lettering should not be underlined except for particular emphasis.

It cannot be emphasized too often that all drawings

TABLE 3



should be so dimensioned that the parts shown thereon can be made without the necessity of scaling the drawing. The given dimensions should include those sizes and distances which are worked to in actual field or shop operation and should be so given that computations will not be necessary. Dimensions should not be duplicated on various views or in a single view except where they will add to the clarity of the draw-

TABLE 4

Electrical Equipment of Buildings

- Ceiling Outlet
- Ceiling Outlet (Gas and Electric)
- Ceiling Lamp Receptacle—Specification to Describe Type such as Key, Keyless or Pull Chain
- Ceiling Outlet for Extensions
- Ceiling Fan Outlet
- Floor Outlet
- Drop Cord
- Wall Bracket
- Wall Bracket (Gas and Electric)
- Wall Outlet for Extensions
- Wall Fan Outlet
- Wall Lamp Receptacle—Specification to Describe Type such as Key, Keyless or Pull Chain.
- Single Convenience Outlet
- Double Convenience Outlet
- Junction Box
- Special Purpose Outlet—Lighting, Heating and Power as Described in Specification
- Special Purpose Outlet—Lighting, Heating and Power as Described in Specification
- Special Purpose Outlet—Lighting, Heating and Power as Described in Specification
- Exit Light
- Floor Elbow
- Floor Tee
- Pull Switch
- Local Switch—Single Pole
- Local Switch—Double Pole
- Local Switch—3 Way
- Local Switch—4 Way
- Automatic Door Switch
- Key Push Button Switch
- Electrolier Switch
- Push Button Switch and Pilot

- Remote Control Push Button Switch
- Tank Switch
- Motor
- Motor Controller
- Lighting Panel
- Power Panel
- Heating Panel
- Pull Box
- Cable Supporting Box
- Meter
- Transformer
- Branch Circuit, Run Concealed under Floor Above
- Branch Circuit, Run Exposed
- Branch Circuit, Run Concealed Under Floor
- Feeder Run, Concealed under Floor Above
- Feeder Run, Exposed
- Feeder Run, Concealed under Floor
- Pole Line
- Push Button
- Buzzer
- Bell
- Annunciator
- Interior Telephone
- Public Telephone
- Local Fire Alarm Gong
- City Fire Alarm Station
- Local Fire Alarm Station
- Fire Alarm Central Station
- Speaking Tube
- Nurse's Signal Plug

- Maid's Plug
- Horn Outlet
- District Messenger Call
- Clock (Secondary)
- Clock (Master)
- Time Stamp
- Electric Door Opener
- Watchman Station
- Watchman Central Station Detector
- Public Telephone—P. B. X. Switchboard
- Interior Telephone Central Switchboard
- Interconnection Cabinet
- Telephone Cabinet
- Telegraph Cabinet
- Special Outlet for Signal System as Described in Specification.
- Battery
- Signal Wires in Conduit Concealed Under Floor
- Signal Wires in Conduit Concealed under Floor Above
- This Character Marked on Tap Circuits Indicates 2 No. 14 Conductors in ½-in. Conduit (see note)
- 3 No. 14 Conductors in ½-in. Conduit
- 4 No. 14 Conductors in ¾-in. Conduit Unless Marked ½-in.
- 5 No. 14 Conductors in ¾-in. Conduit
- 6 No. 14 Conductors in 1-in. Conduit Unless Marked ¾-in.
- 7 No. 14 Conductors in 1-in. Conduit
- 8 No. 14 Conductors in 1-in. Conduit

ings and no more should be given than those necessary.

Dimensions of parts that can be measured or that can be produced with sufficient accuracy by using an ordinary scale should be written in units and common fractions. Parts requiring greater accuracy should be dimensioned in decimal fractions.

Wire, tubing walls, sheet metal, standard structural sections, etc., should be described by commercial designation followed by dimension in decimals.

Dimensions up to and including 72 in. should preferably be expressed in inches, and those greater than this length, in feet and inches.

It is believed that in presenting these various standards in one place, heating and ventilating engineers will be encouraged to follow them more closely than would be the case if they were available only in scattered publications. It is felt advisable to publish not only the symbols dealing directly with heating, ventilating, and air conditioning but also those for associated arts as well inasmuch as it is frequently difficult for younger engineers to attempt to decipher a symbol the meaning of which he does not understand. For that reason the tables on electric equipment of buildings and for plumbing are also presented.

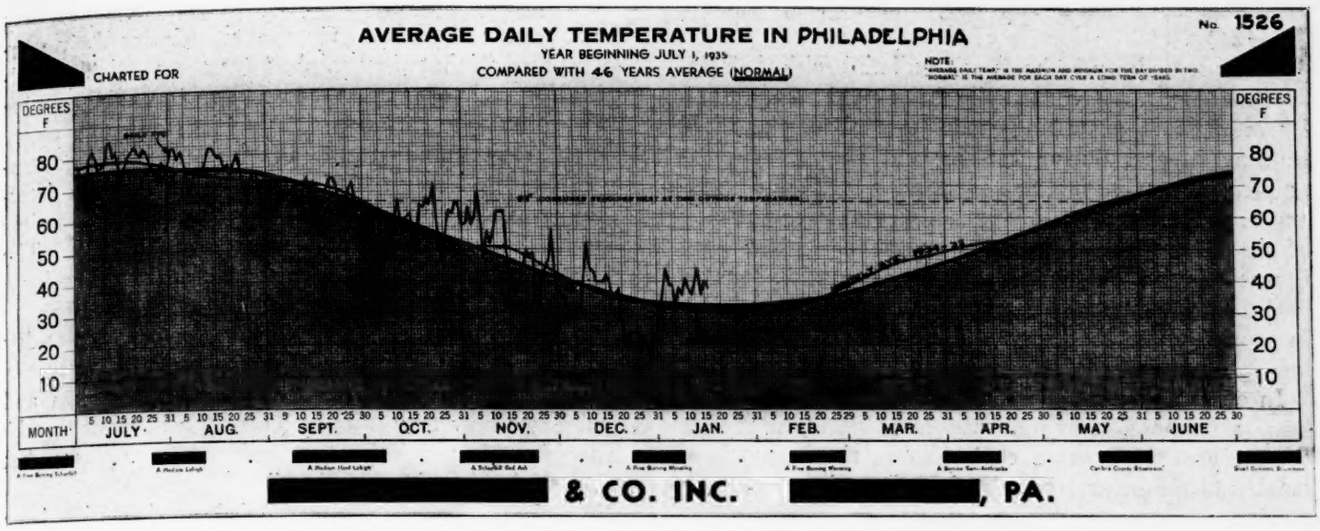


Fig. 1. Temperature chart for Philadelphia as used by the author's company. The heavy black line shows the normal figures, the erratic black line the daily figures, and the smooth black light line is the curve drawn through the monthly averages. The black rectangles were inked in so as to conceal the identity of the author's company during the judging of the Degree-Day Contest papers.

Use of the Degree-Day Unit in the Anthracite Industry†

By C. E. MENGEL‡

IN 1929 we designed a temperature chart (see Fig. 1) which was at first used solely within our organization for the purpose of plotting the average daily temperature and observing the departure from normal during the coal-burning season. Copies of these charts with normals, etc., adjusted to specific cities were given to several of our customers, who plotted on them the temperatures in their locality. They became popular and annually since then we have furnished them to a large number of dealers, coal associations, and others.

Coal-burning requirements for similar periods of time can be compared by means of average temperature figures, but it became apparent to us that the Degree-Day (of which term we learned through HEATING & VENTILATING) would be the ideal unit to use. In 1930 we introduced this term to our customers and, to the best of our knowledge and belief, we were the first anthracite company to use it in advertising or in information to the trade. For the past four years we have given on the back of our temperature charts the degree-days for prior years, leaving space for the current year (see Fig. 1A). We issue a weekly bulletin to the trade and occasionally there is one on the subject of weather. In these, also, degree-days are presented

†Fifth prizewinning paper, HEATING & VENTILATING'S Degree-Day Competition.

‡Assistant to the President, Weston Dodson & Co., Inc., Bethlehem, Pa.

AVERAGE TEMPERATURE & DEGREE DAYS FOR PHILADELPHIA, PA.

MONTH		NORMAL 46 YEARS AVE.		1917/18*		1934/35		1935/36	
		AVE. TEMP.	DEGREE DAYS	AVE. TEMP.	DEGREE DAYS	AVE. TEMP.	DEGREE DAYS	AVE. TEMP.	DEGREE DAYS
JULY		76.2	–	76.4	–	79.3	–	78.2	–
AUGUST		74.8	–	76.7	–	73.2	–	75.3	1
SEPTEMBER		68.0	–	64.4	18	70.8	8	66.0	41
COAL BURNING SEASON	OCTOBER	57.8	242	53.8	347	56.0	280	57.8	233
	NOVEMBER	45.7	588	43.4	648	50.6	433	50.0	455
	DECEMBER	36.3	903	28.0	1,147	35.9	902	31.5	1,039
	JANUARY	32.6	1,001	24.2	1,265	31.0	1,052	29.9	1,090
	FEBRUARY	33.9	895	33.4	885	33.0	893	27.6	1,082
	MARCH	40.8	756	44.4	639	46.2	584	48.3	519
	APRIL	52.1	402	52.2	384	51.6	412	50.2	455
	MAY	62.9	68	67.2	–	60.6	182	65.8	76
	8 MOS.	45.3	–	43.3	–	45.6	–	45.1	–
JUNE		71.4	–	69.6	–	71.5	13		
YEAR (12 MOS.)		54.4	4855	52.8	5,333	55.0	4,759		

*This was the coldest winter in many sections of the East since 1880.

NOTE:—You will find it of interest to keep this tabulation up-to-date.

AVE. TEMP.: Add the daily temperatures you plot on the chart for the current month and divide by number of days and you will get the average for the month.

DEGREE-DAY: A term denoting heat requirements. 65° is generally accepted as the outside temperature at which heat is required inside. The degree-days for a day are the number of degrees the temperature for that day is below 65°; thus for a day with an average temperature of 45°, the number of degree-days is 20. Accumulating these for a month gives the number of degree-days for that month. If every day in a month is below 65°, then the degree-days for the month correspond to the difference between the average temperature and 65°, multiplied by the number of days.

A 30-day month with an average temperature of 45° requires heat (coal) for 20° of temperature, or 600 degree-days; a month with an average of 55° requires heat (coal) for 10° of temperature (300 degree-days) or just ½ of the first mentioned month.

Coal consumption is roughly in proportion to the number of degree-days; direction and velocity of winds has some additional effect.

COAL BURNING SEASON: In most sections of the Anthracite territory, this extends from Oct. to May incl. In the northern areas, and occasionally in other sections, there will be degree-days in the latter part of Sept. and the early part of June, altho for the month as a whole the temperature may be above 65° F.

Fig. 1A. Degree-day data given on the back of Fig. 1 showing the normal number of degree-days, the number in the exceedingly severe winter of 1917-18, the number for the current season, and for the season prior to the current season.

(see Fig. 2, Bulletin No. 229, and Fig. 3, Bulletin No. 124).

These temperature charts and bulletins with their degree-day figures have actually been used many times by retailers in answering complaints about the rapid burning of coal during certain cold periods—for example, February, 1933, and December, 1935, and January and February, 1936. Sometimes a mere showing of the chart to customers was sufficient. Other times it was possible to demonstrate by calculating tons of coal used per degree-day that the quantity burned was in proportion to the heat requirements and not due to inferior quality.

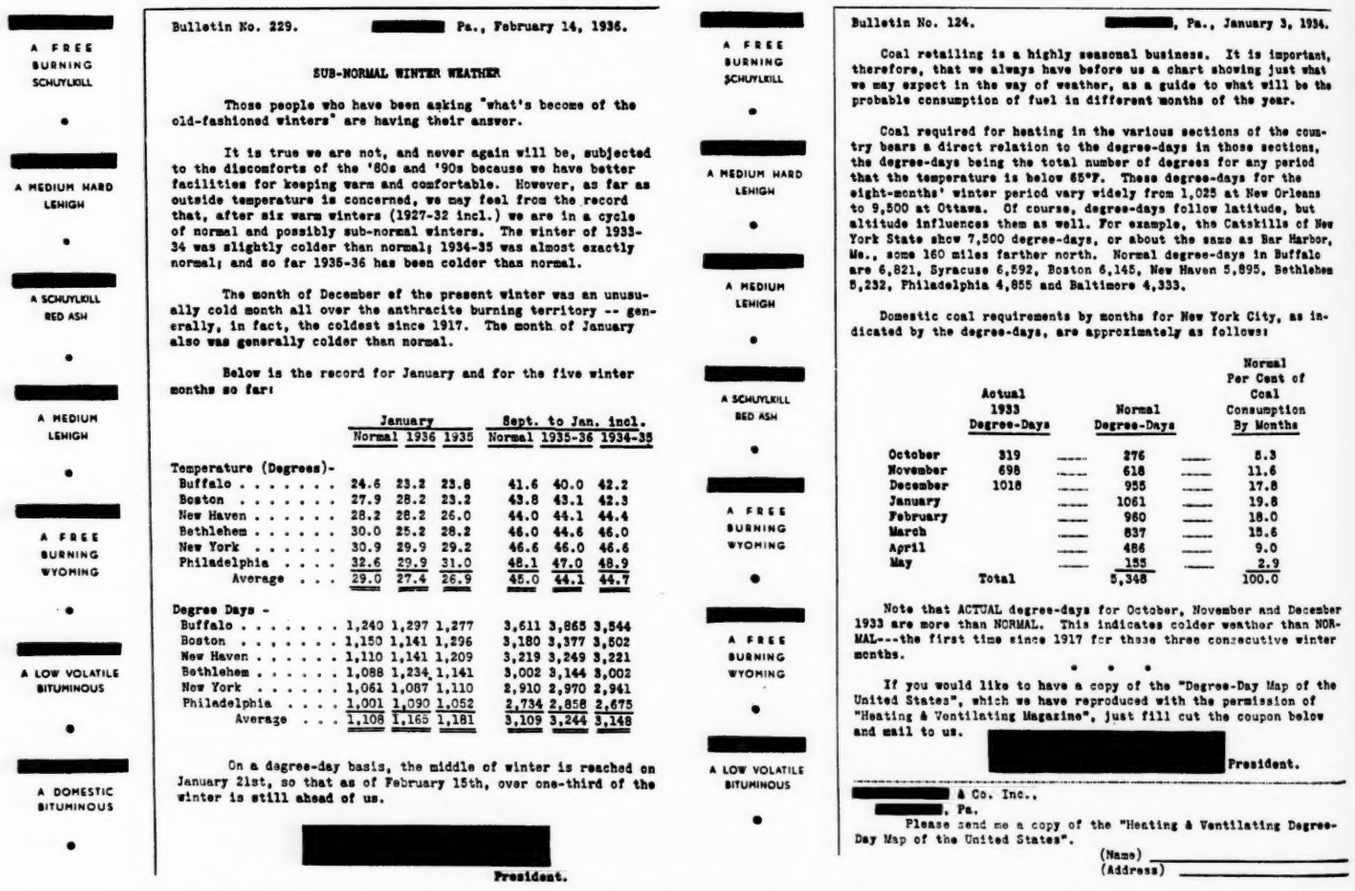
In one specific instance, in a suburb of New York a hospital claimed it had burned in three months of a certain year 16% more coal than in the same three months of the prior year; the Superintendent was very much upset about it. With the degree-day figures available, it was possible to show him that the heat requirement for the period was actually 21% greater than in the prior year and that the efficiency of the coal, in fact, was better. He was not only convinced, but stated that calculating coal requirements on a scientific basis appealed to him. Unquestionably the hospital remained a satisfied customer. We sent one of our temperature charts to the hospital and we understand it has been faithfully kept up to date.

These charts and weather bulletins have stimulated interest in temperature data and we know that a large number of retailers are now getting the United States Weather Bureau daily reports in order that they may have authoritative information. In some instances, they have gotten their local newspaper to print daily temperatures so that they might have them quickly available for their chart. In addition to its tangible value in dealing with customers, retailers (the same as we as anthracite mine operators) have found average temperatures and resulting degree-days of value in determining to what extent the weather has been responsible for the ups and downs in their own business. The Weather Bureau monthly meteorological reports for a number of cities now carry cumulative degree-days.

The retail anthracite trade has become degree-day conscious and we believe that the average consumer, within the next five years, will accept this term and will know how to use it; at least, he will want to take a look at his retailer's chart before he complains that his coal is "burning too fast."

An unexpected development of these charts has been the especial interest in them by several coal retailers who operate an ice business in the summer. They want their blank charts promptly on July 1. Temperature *excess* is as important to them as temperature *deficiency* is to the coal business. We understand that they calculate degree-days on the excess temperature, using 65F as the base. Whether this was ever thought of when the term was originated, we do not know. Of course, the consumption of ice very likely is not as directly in proportion to excess temperature as the consumption of coal is to temperature deficiency, but no doubt there is a decided relation.

We are extending the use of the degree-day into a



A FREE BURNING SCHUYLKILL

A MEDIUM HARD LEHIGH

A SCHUYLKILL RED ASH

A MEDIUM LEHIGH

A FREE BURNING WYOMING

A LOW VOLATILE BITUMINOUS

A DOMESTIC BITUMINOUS

Bulletin No. 229. [redacted] Pa., February 14, 1936.

SUB-NORMAL WINTER WEATHER

Those people who have been asking "what's become of the old-fashioned winters" are having their answer.

It is true we are not, and never again will be, subjected to the discomforts of the '80s and '90s because we have better facilities for keeping warm and comfortable. However, as far as outside temperature is concerned, we may feel from the record that, after six warm winters (1927-32 incl.) we are in a cycle of normal and possibly sub-normal winters. The winter of 1933-34 was slightly colder than normal; 1934-35 was almost exactly normal; and so far 1935-36 has been colder than normal.

The month of December of the present winter was an unusually cold month all over the anthracite burning territory -- generally, in fact, the coldest since 1917. The month of January also was generally colder than normal.

Below is the record for January and for the five winter months so far:

	January			Sept. to Jan. incl.		
	Normal	1936	1935	Normal	1935-36	1934-35
Temperature (Degrees)-						
Buffalo	24.6	23.2	23.8	41.6	40.0	42.2
Boston	27.9	28.2	23.2	43.8	43.1	42.3
New Haven	28.2	28.2	26.0	44.0	44.1	44.4
Bethlehem	30.0	25.2	28.2	46.0	44.6	46.0
New York	30.9	29.9	29.2	46.6	46.0	46.6
Philadelphia	32.6	29.9	31.0	48.1	47.0	48.9
Average	29.0	27.4	26.9	45.0	44.1	44.7
Degree Days -						
Buffalo	1,240	1,297	1,277	3,611	3,865	3,544
Boston	1,150	1,141	1,296	3,180	3,377	3,502
New Haven	1,110	1,141	1,209	3,219	3,249	3,221
Bethlehem	1,088	1,234	1,141	3,002	3,144	3,002
New York	1,061	1,087	1,110	2,910	2,970	2,941
Philadelphia	1,001	1,090	1,052	2,734	2,858	2,675
Average	1,108	1,165	1,181	3,109	3,244	3,148

On a degree-day basis, the middle of winter is reached on January 21st, so that as of February 15th, over one-third of the winter is still ahead of us.

[redacted]
President.

A FREE BURNING SCHUYLKILL

A MEDIUM HARD LEHIGH

A MEDIUM LEHIGH

A SCHUYLKILL RED ASH

A FREE BURNING WYOMING

A FREE BURNING WYOMING

A LOW VOLATILE BITUMINOUS

Bulletin No. 124. [redacted], Pa., January 3, 1934.

Coal retailing is a highly seasonal business. It is important, therefore, that we always have before us a chart showing just what we may expect in the way of weather, as a guide to what will be the probable consumption of fuel in different months of the year.

Coal required for heating in the various sections of the country bears a direct relation to the degree-days in those sections, the degree-days being the total number of degrees for any period that the temperature is below 65°F. These degree-days for the eight-months' winter period vary widely from 1,025 at New Orleans to 9,500 at Ottawa. Of course, degree-days follow latitude, but altitude influences them as well. For example, the Catskills of New York State show 7,500 degree-days, or about the same as Bar Harbor, Me., some 160 miles farther north. Normal degree-days in Buffalo are 6,821, Syracuse 6,592, Boston 6,145, New Haven 5,895, Bethlehem 5,232, Philadelphia 4,855 and Baltimore 4,333.

Domestic coal requirements by months for New York City, as indicated by the degree-days, are approximately as follows:

	Actual 1933 Degree-Days		Normal Degree-Days		Normal Per Cent of Coal Consumption By Months
October	319	----	276	----	5.3
November	698	----	618	----	11.6
December	1018	----	955	----	17.8
January		----	1061	----	19.8
February		----	960	----	18.0
March		----	837	----	15.6
April		----	486	----	9.0
May		----	155	----	2.9
Total			5,348		100.0

Note that ACTUAL degree-days for October, November and December 1933 are more than NORMAL. This indicates colder weather than NORMAL---the first time since 1917 for those three consecutive winter months.

• • •

If you would like to have a copy of the "Degree-Day Map of the United States", which we have reproduced with the permission of "Heating & Ventilating Magazine", just fill out the coupon below and mail to us.

[redacted] President.

[redacted] & Co. Inc.,
[redacted], Pa.
Please send me a copy of the "Heating & Ventilating Degree-Day Map of the United States".
(Name) _____
(Address) _____

Fig. 2 (Left) and Fig. 3 (Right). Samples of weekly bulletins published by the author's company for their dealers, these being examples of the attention paid by the coal trade to degree-days.

followup system on coal orders. A ton of coal in a given community for a given size house is equivalent to a definite number of degree-days. The retailer can thus readily calculate the equivalent degree-days for a certain quantity of coal and place it on the customer's record card. After posting against this record the actual degree-days as they occur during subsequent weeks and months, he can readily tell when the coal has been burned to a point when a followup should be made. In the past, retailers have been following up more or less on a hit-or-miss basis, with some of them making an attempt to calculate, on the basis of normal temperatures, how long a quantity of coal would last, with a consequence that, due to intermittent cold or warm spells, the followup was either too early or too late. The degree-day basis substitutes facts for guesswork in determining when a customer needs an additional supply of anthracite.

Electric Panel Heating for British House of Commons

LORD STANHOPE, Britain's First Commissioner of Works, has issued for the information of members of Parliament some data on the ventilation of the House of Commons.

Ventilation of the debating chamber is effected by a system which draws air from the river front through intakes under the terrace of the House, passes this air through a washing screen, along a main airway, and when necessary through a fog filter, to heating and equalizing rooms from which the air is admitted to the debating chamber through the perforated floor, slots under the benches, the sides of the table, vertical inlets at both ends of the House, and narrow slits under the side galleries. The air passes upwards through the chamber and is extracted round the raised panelling of the ceiling.

Warmed air also supplies the division lobbies and members' retiring rooms, which are in turn connected to the air extraction system. The fireplaces in the division lobbies constitute further means of air extraction.

An auxiliary ventilation system drawing from the main airway supplies the members' side galleries, the reporters' and ladies' gallery, and the strangers' gallery, the air being admitted through slots under the seats into the chamber from which it is extracted with the other air through the ceiling. The air can be heated, before admission, to any reasonable temperature above that of the outside air. At present, however, there is no means of cooling the air below that of the atmosphere.

Quality of Air

In 1934, tests were carried out by the Government Chemist who reported that there were no indications of impurity in the air, that there were no traces of carbon monoxide emanating from the combustion of fires, that the amount of additional carbon dioxide produced by occupation was much below what experts consider an index of insufficient ventilation.

Admission and Distribution

The Select Committee of 1913 reported, after taking expert evidence, that the present method achieves a result the reverse of that which is desired; it produces a cooling effect on the feet and gives insufficient air movement around the head, whereas the ideal is to keep the feet warm and the head and shoulders comparatively cool. The Committee concluded that the defects are due to the method of distribution of the air rather than to its quality.

After the war, experiments were carried out to ascertain the best method of applying the 1913 conclusions, and in 1924 a plan was prepared for the rearrangement of the ducts at an estimated cost of $20,750.

Opinion in the House being divided on the merits or demerits of the existing system, it was not proceeded with and was deferred from year to year. There was no evidence that the existing system was prejudicial to health.

In 1930, representations were made by members to the then First Commissioner of Works, and in 1931 it was decided to refer the question to the Joint Committee of the Department of Scientific and Industrial Research and the Medical Research Council, which reported in 1932 that no further investigations were required as the 1924 plan would probably meet the case.

Since that time attention has been drawn to the air conditioning methods adopted in warmer climates and in certain London hotels, and consideration has been given to the desirability of installing such a system in the House of Commons.

It would be practicable, at a high cost, to install a system enabling air of any desired temperature and humidity to be provided, but experts disagree as to the right conditions of humidity for comfort and health, and Lord Stanhope considers that until consensus of authoritative opinion has been reached it would be premature to embark on a plan.

As already stated, the air is warmed before being brought into the Chamber. It is believed that the drowsy feeling experienced during long sittings is produced not by any appreciable vitiation of the air but by the breathing during long periods of air of a comparatively high temperature. The necessity of raising the temperature during the early hours of a sitting to avoid complaints of coldness accentuates this feeling of stagnation.

It is, therefore, considered that, without embarking on a system of humidity control, an improvement

would be effected during cooler weather by bringing the air into the Chamber at a rather lower temperature than at present and by providing local radiant heating units. For the front benches it would be necessary to provide water heated units in the floor and these would not be subject to individual control. For the other benches, electric panels fixed on the backs of the seats would be used enabling them to be controlled by members (two control switches to every three members).

In the first instance, it is proposed to provide and fix a small number of sample electric panels. Three months will be required for this with a view to deciding by experiment the right surface temperature. Until experimental work has been carried out it will be impossible to prepare a firm estimate of the cost of the whole work, which would be approximately $30,000.

If provision is made in due course for the complete heating installation the system will, according to Lord Stanhope, effect a very material improvement. If, thereafter, conditions are still unsatisfactory, consideration will be given to the desirability of carrying out an alteration of the method of admission and distribution of air. This would cost approximately $25,000.

Lastly, when a report on investigations as to the humidity is available and an opinion formed as to the best conditions to be attempted, consideration will be given to the desirability of humidity control, including the cooling of the air during summer months. The cost of this would approximate $100,000 and, as regards the cooling aspect, it must be remembered that in an average summer the number of days during the session upon which cooling is called for are very few.—*Geoffrey Blackall.*

Ventilation in a Municipal Garage

By FRANCIS C. HOLBROOK†

ONE of New York's largest municipal garages, to be erected adjacent to the new incinerator plant at West 56th Street and 12th Avenue by the Department of Sanitation, presented a problem in ventilation that directed some thought to the concentration of carbon monoxide gas from the exhausts of a large fleet of trucks and other motorized equipment.

The garage, a four-story structure, is designed to house about sixty trucks on the first and second floors, respectively. These trucks will leave the building within a period of one hour for collection service and may return in the same sequence for housing. Because of this mass operation it became apparent that provision would have to be made for sufficient ventilation to hold the CO concentration within safe limits.

Before the design of the ventilating system was begun, an investigation of the quantity of CO generated by motors of the type used on the collection trucks and the resistance of the human body to various concentrations of CO was made to determine a practical quantity of fresh air to be supplied during periods of maximum service demand. Valuable information was assembled from the test data used in the design of the ventilating system for the Holland Tunnel, and the new Post Office building at 33rd Street, and an engine exhaust test conducted at the department repair shop by City Service engineers.

From these investigations it was calculated that an engine will generate about ninety cubic feet of CO in an hour when running at 800 r.p.m., or about ten miles per hour. Also an examination of tests conducted by the Holland Tunnel authorities, to record the reactions of the human body to concentrations of CO over different periods of time, revealed the fact that it is not harmful to maintain a concentration of six parts in ten thousand for one hour.

† Mechanical engineer, Department of Sanitation, New York, N. Y.

For the design of the system it was assumed that an average of 25% of the motors would be idling, accelerating, or running during the period of one hour while trucks were preparing to leave the building. The production of CO as determined by test was assumed to represent an average of these operating periods. Consequently,

$$\frac{0.25 \times 90 \times 10{,}000 \times 60}{60 \times 6} = 37{,}000 \text{ c.f.m.}$$

of supply air for each floor was necessary.

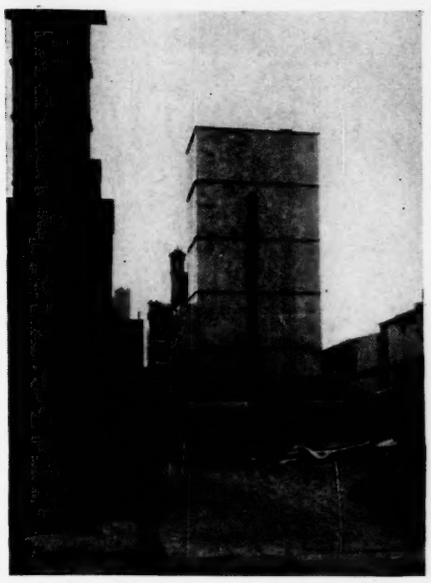
This air will be introduced through ceiling ducts of sufficient number and size to maintain the minimum concentration at the driver's seat. Two supply fans of 18,500 c.f.m. will be installed with copper fin heaters to temper the air during the winter months to a temperature of 50F leaving the fan. It was estimated that an air velocity of 1,200 f.p.m. leaving the fan was necessary to produce a high degree of air and gas mixing.

To prevent uncontrolled volumes of vitiated air from entering lockers and toilet spaces, it was decided to provide an exhaust system. Air will be withdrawn at the bases of columns through grilles of heavy welded plate steel and through vertical ducts reenforced to take the impact of a truck. Two exhaust fans of 18,500 c.f.m. capacity will discharge the gas laden air to vertical ducts extending to the roof.

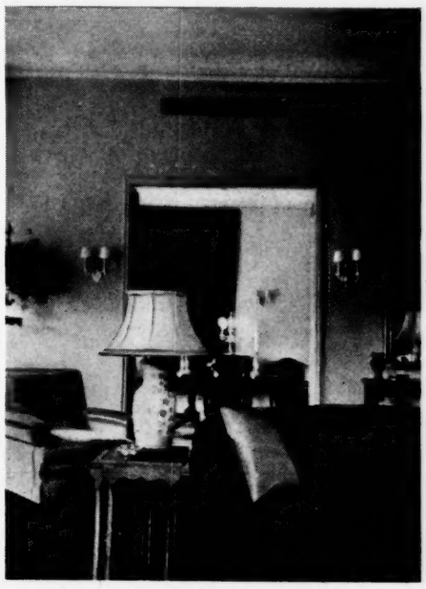
Experience will dictate the most desirable combination of units for seasonal requirements. For instance, during the months of extreme cold weather, it may be necessary to operate both supply and exhaust fans, whereas during mild weather the exhaust fans may be sufficient. Wide flexibility of control is possible through the proper operation of combined units. It might be said in conclusion that the degree of concentration as permitted would never be reached because of the direct withdrawal of exhaust gases through the exhaust grilles from a large proportion of trucks.

First Large Air Conditioned Apartment House

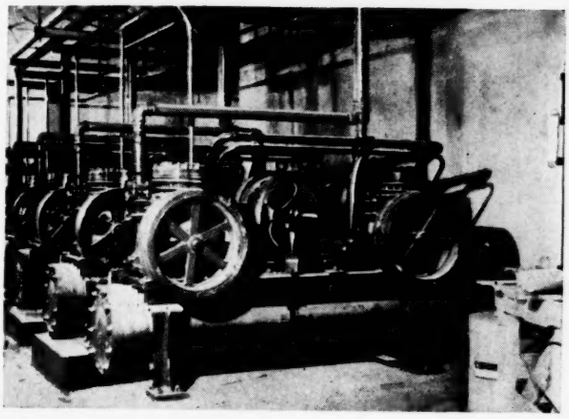
Here are some views of the first large apartment building to be completely air conditioned. This building, on New York's exclusive Park Avenue, has 44 apartments containing a total of 253 rooms. Detailed information on the installation appeared in the May, 1936 issue, page 51



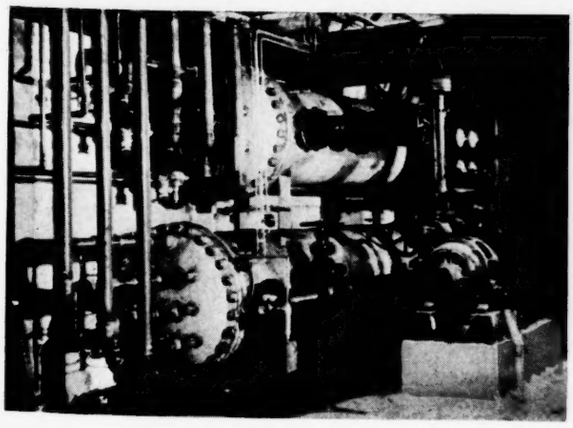
Forced draft cooling tower on roof.



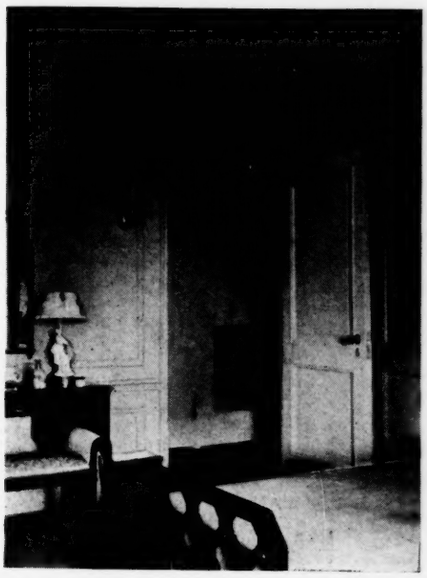
Grille over door supplies conditioned air to living room.



Six 20-ton compressors in machine room are used for cooling.

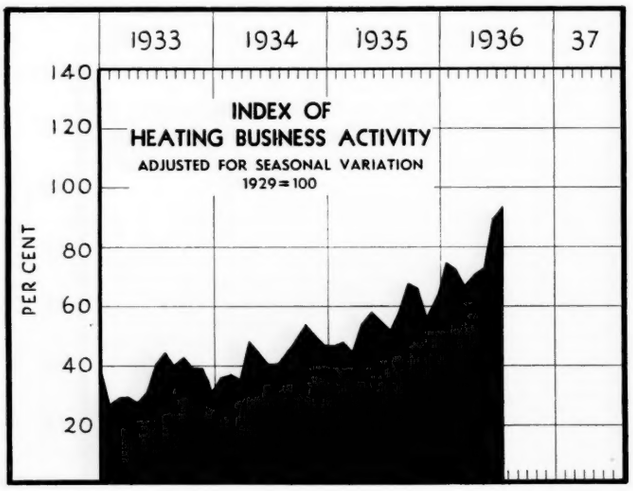


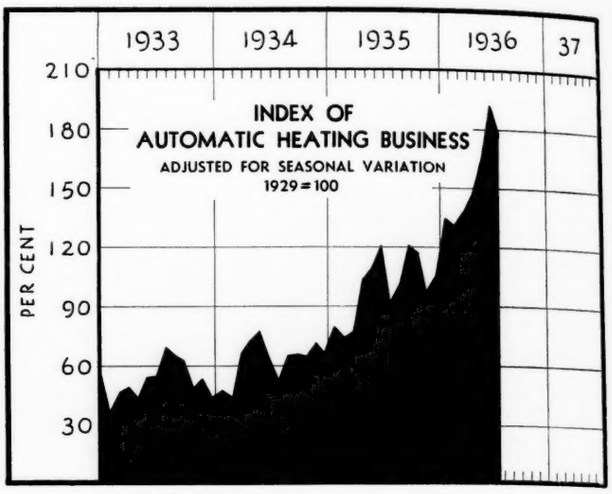
Condenser and chilled water cooler.

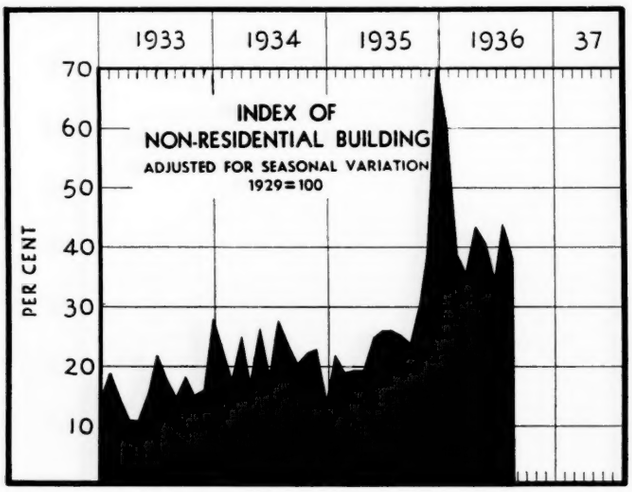


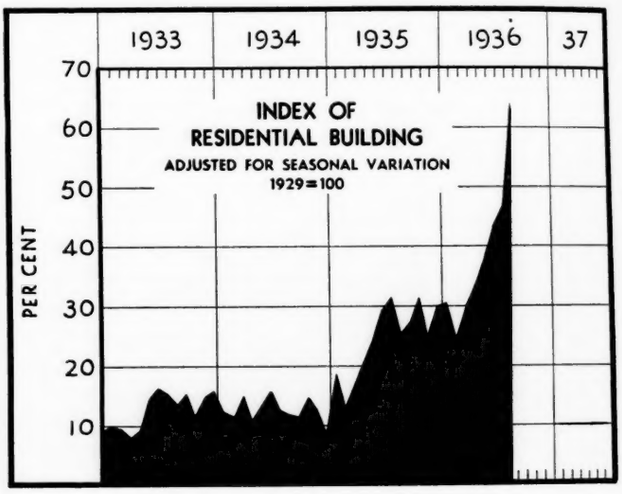
Grille in hall returns air to conditioning unit.

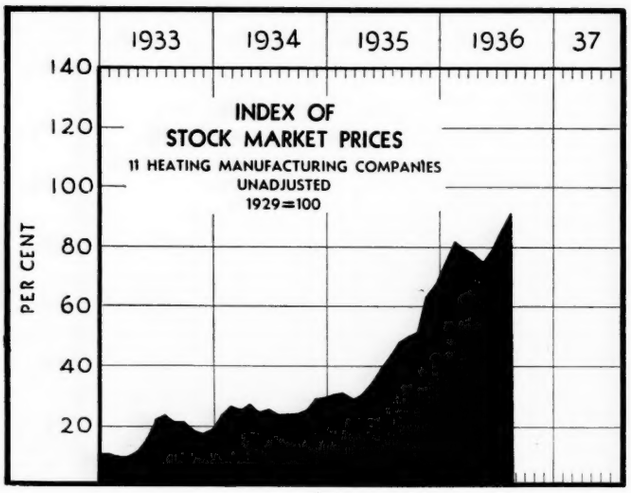
HEATING BUSINESS TRENDS

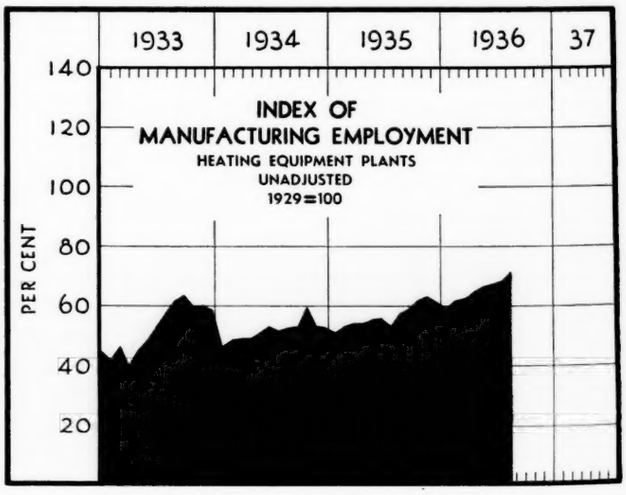












Heating Business Continues to Gain; Now at 95% of 1929 Levels

BUSINESS activity in the industry as reflected in HEATING & VENTILATING's Index of Heating Business continued to increase during July, when the Index reached 94.7% of 1929 levels. As has been pointed out, this index is one of physical volume of business and it does not necessarily imply that the dollar value of heating contracts is at 95% of 1929 levels; it does show the quantity of equipment being installed.

Due to a slightly more than seasonal decline in stoker and oil burner sales, HEATING & VENTILATING's Index of Automatic Heating Business dropped from 189.9 in June to 178.7 in July. This Index is also based on 1929 = 100 and indicates that the total number (weighted) of oil burners, gas-fired equipment, and stokers is running in sales about 80% above 1929 levels.

One of the most striking improvements in business has been that of residential building, which in August attained a level of activity not seen since March, 1931, according to figures just released by F. W. Dodge Corporation. The August volume of residential building exceeded the July volume by about 41%, and when adjusted for seasonal variation this resulted in the Index of residential buildings increasing from 47.6 to 64.9 (1929 = 100). During August, non-residential building dropped, resulting in a decline of that Index from 44.2 to 37.3. The two indexes on building are in dollar value of contracts in 37 eastern states.

Although the final reports are not as yet available, primary figures indicate that summer air conditioning during 1936 increased approximately 6% over 1935. Examination of figures on summer air conditioning and winter air conditioning also for the first six months of the year would indicate that winter air conditioning will show a much sharper increase in 1936 than the summer type of equipment. The figures also apparently indicate that the greatest increase in sales of summer air conditioning equipment in 1936 as compared with 1935 took place in the smaller cities.

Gas heating increased 14% from July 1, 1934, to July 1, 1935, according to a recent report of the American Gas Association summarized below.

HEATING AND AIR CONDITIONING BUSINESS TRENDS

INDEXES (1929 = 100) (Seasonally Adjusted)	July, 1936	July, 1935
HEATING & VENTILATING'S Index of Heating Business	94.7	52.6
HEATING & VENTILATING'S Index of Automatic Heating	178.7	94.8
HEATING & VENTILATING'S Index of Contractor Activity	78.1	43.9
HEATING & VENTILATING'S Index of Heating Equipment Prices	81.0	73.0
INDEXES (1929 = 100) (Seasonally Adjusted)	**August, 1936**	**August, 1935**
HEATING & VENTILATING'S Index of New Non-Residential Building Contracts	37.3	25.6
HEATING & VENTILATING'S Index of New Residential Building Contracts	64.9	26.2
HEATING & VENTILATING'S Index of Stock Prices (Unadjusted)	92.5	48.3
HEATING & VENTILATING'S Index of General Business	93.2	79.2
HEATING & VENTILATING'S Index of Employment in Heating Equipment Manufacturing Plants	72.3	57.9
EQUIPMENT SALES	**July, 1936**	**July, 1935**
Mechanical draft oil burners, number of units	13,952	7,608
Oil burner-boiler units, number	1,230	744
Oil burner-furnace units, number	556	197
Blowers for public buildings, dollars	139,386	81,218
Small housed blowers, dollars	146,627	58,285
Propeller fans, dollars	600,534	217,368
Unit air conditioners, self-contained, dollars	321,824	—
Unit air conditioners, other, dollars	678,146	—
Central air conditioning systems, comfort, dollars	408,283	—
Central air conditioning systems, industrial, dollars	49,040	—
Refrigerating medium for air conditioning, dollars	124,581	—
Air filters, dollars	11,648	—
Humidifiers, dollars	101,552	—
Air washers, dollars	65,738	24,350
Unit heaters, dollars	480,989	226,085
Unit ventilators, dollars	123,926	112,356
Cast iron radiators, thousand sq. ft.	8,027	4,675
Steel boilers, number	757	355
Stokers, class one, number	5,488	2,872
Stokers, class two, number	316	190
Stokers, class three, number	148	96
Indirect heating surface, non-ferrous, dollars	141,652	88,055
Indirect heating surface, cast-iron, dollars	13,892	6,491
Non-ferrous convectors, sq. ft.	541,701	248,426
Cast iron convectors, sq. ft.	802,851	271,623
Round boilers, thousand pounds	3,905	3,647
Square boilers, thousand pounds	29,200	16,332

NUMBER OF GAS-FIRED CENTRAL HOUSE HEATING INSTALLATIONS, JULY 1, 1935 AND JULY 1, 1934

	1935	1934	% INCREASE
169 MANUFACTURED GAS COMPANIES			
Gas-designed boilers	25,600	25,170	1.7
Converted boilers	15,978	11,681	36.8
Total boilers	41,578	36,851	12.8
Gas-designed furnaces	11,112	10,084	10.2
Converted furnaces	11,239	7,898	42.3
Total furnaces	22,351	17,982	24.3
Total, 169 companies	63,929	54,833	16.6
87 NATURAL GAS COMPANIES			
Gas-designed boilers	5,390	5,074	6.2
Converted boilers	11,714	10,126	15.7
Total boilers	17,104	15,200	12.5
Gas-designed furnaces	21,377	19,273	10.9
Converted furnaces	32,616	29,143	11.9
Total furnaces	53,993	48,416	11.5
Total, 87 companies	71,097	63,616	11.8
TOTAL, 256 COMPANIES			
Gas-designed boilers	30,990	30,244	2.5
Converted boilers	27,692	21,807	27.0
Total boilers	58,682	52,051	12.7
Gas-designed furnaces	32,489	29,357	10.7
Converted furnaces	43,855	37,041	18.4
Total furnaces	76,344	66,398	15.0
GRAND TOTAL	135,026	118,449	14.0

Yearly Costs from Degree-Days†

By LORIN G. MILLER‡

IF we are to judge accurately the performance of our heating plant it is necessary to set up a standard which must be adaptable to all conditions. The degree-day record makes it possible to develop a simple but reliable formula by which the efficiency of any plant may be easily calculated.

It is the object of the author to present a method of developing such a formula to fit any specific case and as a byproduct to have a statement applicable to the general case.

The heat loss, h, per hour, per degree Fahrenheit difference between inside and outside temperature is given with a fair degree of accuracy by Carpenter's formula where $h = 1/4W + G + 0.02C$. In this statement W = net outside wall and ceiling area in square feet, G = sash area in square feet, and C = cubical contents of heated space in cubic feet. Casual inspection of the statement reveals the fact that the average conductivity of the wall is taken at 0.25, of sash at 1.0, and that one air change per hour is anticipated. Where values in specific cases are known to be different they may be substituted in the interest of greater accuracy, otherwise the results obtained will apply to average use and construction.

Since many accountants allocate charges against space by square foot of floor, and also since it is easier to measure or estimate than volume, this formula will use this unit as the basic space unit.

Some general assumptions must be made to reduce wall, glass, and roof areas to floor area. When advantage is to be taken of natural illumination, as in most shop and factory buildings, where extreme length is to be avoided, the bays will usually not be much greater or less than 50 ft. Sash area, in these commercial type buildings, is about 40% of the floor area. If we let A represent the floor area, then $G = 2A/5$ and the room length $L = A/50$. Ceiling heights in factory, office, storage, and similar space will be near 15 ft. Using this value the gross wall area becomes

$$\left(\frac{2A}{50} + 100\right)15 = \frac{3A}{5} + 1500$$

The net wall area

$$W = \frac{3A}{5} + 1500 - \frac{2A}{5} = \frac{A}{5} + 1500$$

The cubical contents $C = 15A$. With these results substituted in Carpenter's formula the statement becomes

$$h = \tfrac{1}{4}\left(\frac{A}{5} + 1500\right) + \frac{2A}{5} + .02 \times 15A$$

which simplified is $h = 3/4A + 375$. This neglects loss through ceilings. Assuming a coefficient of heat transfer $U = 0.25$ the heat loss through ceiling of a one-story building $= 1/4A$; of a two-story building $1/2A$, and of an S-story building $A/4S$. The complete statement of heat loss, therefore, is

$$h = \frac{3A}{4} + \frac{A}{4S} + 375 \text{ B.t.u. per hr. per F.}$$

Multiplying by 24 to get heat loss per day the equation becomes

$$H = 18A + \frac{6A}{S} + 9000 \text{ B.t.u. per day per F.}$$

If we use D.D. as the symbol representing the degree-day value for the locality and season in question then

$$H = D.D.\left(18A + \frac{6A}{S} + 9000\right) B.t.u.$$

Now, if T represents the tons of coal burned per season, K its calorific value, and E the efficiency of the heating system, H becomes 2,000 TKE and the equation may be written

$$2{,}000\ TKE = D.D.\left(18A + \frac{6A}{S} + 9{,}000\right)$$

or rewritten in terms of efficiency

$$E = \frac{D.D.\left(18A + \frac{6A}{S} + 9{,}000\right)}{2{,}000 \times TK}$$

which affords a quick check on the plant performance.

To illustrate, suppose a three-story building in Detroit has a total of 15,000 sq. ft. of floor space and burns 125 tons of 14,000 B.t.u. coal per season. The degree-days for the season are 6,200.

$$E = \frac{6{,}200\left(18 \times 15{,}000 + \frac{6 \times 15{,}000}{3} + 9{,}000\right)}{125 \times 2{,}000 \times 14{,}000}$$

$$= 55\% \text{ approx.}$$

A similar treatment of residences yields an equation where $H = 15A$ or

$$E = \frac{D.D. \times 15A}{2{,}000\ TK}$$

As a further illustration take the case of a residence using 2,400 sq. ft. of heated floor area which burns 15 tons of 14,000 B.t.u. coal during a 6,200 degree-day season. The efficiency of the plant becomes

$$E = \frac{6{,}200 \times 15 \times 2{,}400}{2{,}000 \times 15 \times 14{,}000} = 53\% \text{ overall}$$

The object of this discussion is obviously the presentation of a method of developing a formula whereby the valuable information presented as degree-day data may be quickly used with whatever accuracy may be demanded. If the formulas developed are of any value they are merely byproducts and beyond the author's intention.

†Fourth prizewinning paper, HEATING & VENTILATING's Degree-Day Competition.

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Madison Square Garden Invests in Modern Cooling

ADVANCES in the science of air conditioning and air handling have been numerous during the past ten years and with the equipment as now available it is practicable to design systems to give results not possible a decade ago.

The president of the Madison Square Garden Corporation, Col. John Reed Kilpatrick, realizing this, early this year recommended changing and modernizing the existing air conditioning system so as to make it comparable with the systems installed today. The large size of the Garden together with the unusual uses to which this building is put make the problem a difficult one. Practically every type of sport and exhibition has appeared in the Garden. Ice skating, hockey, circus, rodeo, horse shows, bicycle races, track meets, basket ball games, boxing and wrestling matches are just a few of the sports and shows which regularly use the Garden. Naturally, such a wide variety of uses make necessary an extremely flexible system.

The overall volume of the arena is approximately five million cubic feet of which about three and half million are below the ceiling, the remainder above. The space above the ceiling is occupied by the roof, trusses, lights, fan rooms and cat walks. The maximum seating capacity of the Garden is approximately 18,500.

A number of features set this installation apart from the usual air conditioning job. First, the peak interior load occurs at a time when the outdoor temperature is relatively low. Most of the exhibitions held at the Garden occur between 8 and 11 in the evening and at these times it is cool outside. Second, a large amount of air for ventilation must

be supplied because practically all the occupants smoke during the exhibitions. In fact, it was found necessary to arrange the dampers so that large amounts of outside air could be supplied for brief periods to purge the air when the amount of smoke becomes excessive. Third, a large heat load is caused by the floodlights used to illuminate the arena during exhibitions.

The cooling and air distribution system is so designed that the occupied portion of the arena will secure the maximum cooling and ventilation. The large volume from the arena seat level to the ceiling is, except for the exhaust air removed by two openings near the center foot lights, practically a dead area. Above the ceiling is another large space with a volume of approximately 1½ million cubic feet. No ventilation is provided for this volume as it is not occupied at any time. Thus, it might be said that the system is a local one and cooling is provided only where it is needed.

Summer Operation

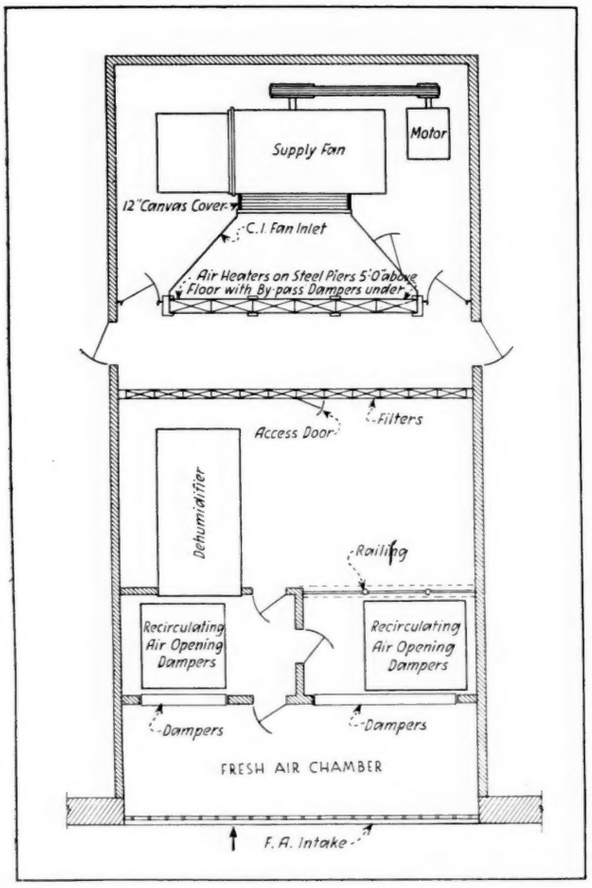
During the summer the air conditioning system will supply a constant amount of cooled and cleaned air to the occupants of the building. Outside air will be drawn in from louvers in the outer walls of the fan rooms and will pass through air washers, filters and heaters, the last not being in use during the summer. The dampers are so arranged that a minimum of 10 c.f.m. of outside air will be supplied for each person. At times when the outdoor temperatures approach a comfortable level this amount of air will be increased. The remainder of the air to the arena will be recirculated air, drawn out of the arena through registers underneath the seats at the stadium level. Registers are located at approximately every other seat.

Supply air from the fan room is distributed by means of a combined down draft and injector system. Discharge openings in the ducts are located at the ceiling above the various seating spaces. The large central area at arena floor level is supplied with conditioned air by means of injectors which project a high velocity air stream into this area.

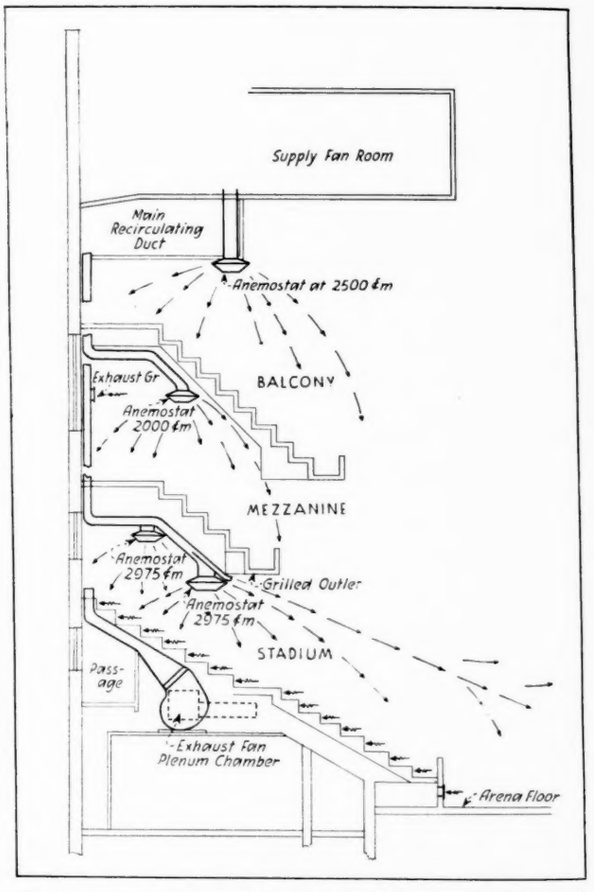
Recirculated air is withdrawn from the arena through exhausts under the permanent seats in the stadium level. The air then flows through a plenum chamber underneath the seats where a system of ducts carries it to fans. It is then forced back into the plenum space located at the ceiling level directly under the supply fan rooms. It is also possible to exhaust this air directly to the outdoors by means of dampers suitably located. Exhaust air is removed and expelled to the atmosphere directly from two large outlets located in the ceiling near the large central flood lights and also through openings in the rear of the balconies.

Supply Fan Rooms

There are eight supply fan rooms located near the ceiling in the main arena which supply all of the ventilation and cooled air to the Garden. Pneumatically controlled dampers regulate the amount of air required for the supply system. All of this air passes through



Plan of a typical fan room. There are eight of these supplying all of the conditioned air for the arena and lobbies.



Cross-section of one side of the Garden. Supply and exhaust ducts are located in the outer walls of the building.

A view taken during the Annual World Championship Rodeo which will be held this year from October 7 to 25.

the air washers during the time when cooling is being done. When ventilation, either heated or otherwise, is being supplied, the outside air is bypassed around the spray chamber. The chilled water for the air washers is obtained from three 266-ton compressors which are also used during the winter for freezing the ice hockey and ice skating surfaces. These machines are turbine-driven, of the centrifugal type, and employ dichloroethylene as a refrigerant. City water is used to cool the refrigerant condenser and is also used in the turbine condensers before it is discharged into the sewer. Chilled water is taken at 40F from a cooler and is forced by three 640-g.p.m. main pumps and two 1,800-g.p.m. booster pumps to the spray chambers in the eight fan rooms which are located approximately 100 ft. above the engine room.

After the outside air leaves the air washer it is mixed with recirculated air taken from the large plenum space located below the supply fan room.

The air is then passed through a bank of glass type filters made up of 60 units, each 20 in. square. In back of this is a bank of air heaters of the extended fin type having a capacity sufficient to raise the temperature of the air 50F. During the summer and at other times when there is no need for heating, the air is passed through damper openings located beneath the heater coils. Eight blowers capable of handling 48,000 c.f.m. each, supply air through various distribution ducts to the air outlets. The air distribution system is capable of supplying approximately 384,000 c.f.m. to the arena. This air is conveyed from the eight supply fan rooms by large sheet metal ducts to sheet metal flues located in the outer walls running in the perimeter of the building.

Air Inlets

Two types of air inlets are utilized to introduce the air into the arena. The first type is an injector located at a height approximately 25 ft. above the arena floor which is merely a directional register through which high velocity air (1,000 f.p.m.) is passed. As stated before it was necessary to use this type of inlet in order to condition the large area at the center of the arena as the ceiling is approximately 80 ft. above the floor and it is not possible to place inlets at the ceiling level. Sixteen injectors are used, having capacities ranging from 2,100 to 6,400 c.f.m.

The permanent seating spaces, that is the stadium seats, mezzanine, and balcony are served by Anemostats. These are patented devices designed to supply high velocity air without objectionable noises or drafts. They are made up of a number of truncated cones which are so arranged that they break up and expand the high velocity air stream to a velocity such that it will not be noticeable.

Due to a slight vacuum which is formed at the apex of the cones some of the room air is drawn in, mixed with the conditioned air, and forced out through the outlet cones into the conditioned area. The cones can be arranged to give practically any distribution desired. There are a total of 102 of these devices installed with capacity ranging from 2,000 to 5,000 c.f.m. and utilizing an entrance velocity of approximately 1,000 f.p.m.

Recirculation System

Practically all of the air which is recirculated is withdrawn from the arena through grilles located beneath the stadium seats. There are also a few grilles in the back of the mezzanine section which also pick up recirculated air. The main purpose of these latter grilles is to create a positive circulation in the mezzanine areas.

The lower section of the arena is used as a source of supply for recirculated air because experience has shown that the air in this area is cleaner and more desirable than in other sections.

A large plenum space beneath the stadium seats acts both as a collection chamber for the recirculated air and as a fan room for the recirculating fans. It was found necessary to install eight of these fans, each capable of moving 22,500 c.f.m. from the recirculated chambers. The air from the fans is carried by means of sheet metal flues up to the main recirculating masonry duct which runs below the supply fan rooms. The recirculated air from the end stadium seats is carried

by flues up to the space above the ceiling and then over to the masonry duct underneath the supply fan rooms. Two damper openings lead from the masonry duct to each fan room. These dampers are pneumatically controlled so as to regulate the amount of air which is being recirculated.

Exhaust System

It is also possible to exhaust the air from the stadium seats directly to outdoors by opening suitable dampers in the flues to the masonry duct. The exhaust dampers in the ducts from the side stadium seats are located in the outer wall at about the same height as the mezzanine. The ducts from the end stadium seats have chambers so arranged that the air can be discharged into the main exhaust fan rooms and then to the outdoors. The main exhaust system withdraws air through two large openings located in the ceiling near the large central flood lights and also through openings in both ends of the balcony. The two large outlets in the ceiling were installed primarily to remove the smoke and dust which collects in the air at this point. These outlets will also serve to remove some of the heat given off by the large central flood lights. Air from these two openings and the end balcony openings flows to the two exhaust chambers. Each of these chambers has a fan which has a capacity of 80,000 c.f.m. and both fans discharge the exhaust air through openings in the roof.

A system of recording instruments for indicating the temperatures in the arena in several locations and at various levels is provided. The indicating instruments are all located in the engineer's office so that he can easily check on the conditions in almost any part of the arena. Temperature measuring devices are also located in all of the fan discharge ducts and the conditions are indicated in the engineer's office. Speed controls for all fans are remotely operated also from the engineer's office.

This installation was made under the general direction of Airtemp, Incorporated and was designed and installed by Airtemp New York Sales Corporation. R. Donopria was the engineer for the Madison Square Garden Corporation.

Noise and Dirt Force Building to Air Condition

UNUSUAL reasons recently lead to an air conditioning installation in the four-story office building of the Sloss Sheffield Steel & Iron Co., Birmingham, Ala., this being the first major office building installation in the city.

The building is located in an industrial area and adjacent to one of its operations. An iron furnace with its numerous smokestacks is located on one side of the building, a spray pond on another, a concrete mixing plant with its continual grinding on another, and two or three railroad lines on another.

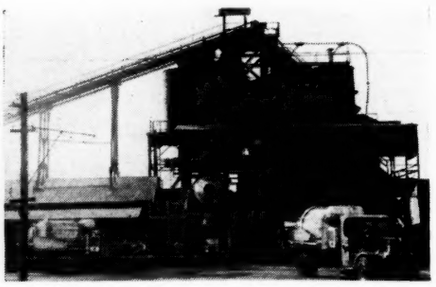
A 25-ton installation now enables this concern to manufacture its own weather and to close the windows, thereby keeping out noise and contaminated air of the outside.

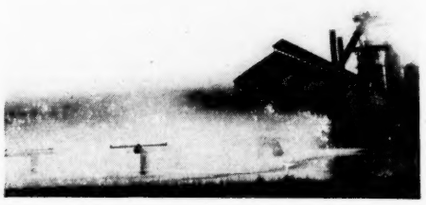
This installation is also noteworthy in that the company manufactured and installed its own insulation which was used for the ceilings on each floor. Slag, a by-product of its iron furnace, was taken, heated to a molten mass and a draft of air blown through it, creating a type of rock wool, which was used on the job.

The office building has 8,500 sq. ft. of surface and includes 38 rooms. Each floor has two main supply ducts with automatic zone control.

The building has its own steam heating plant, but the air conditioning installation is equipped with a low pressure steam coil in order to temper the outside air in the winter. Thus, a uniform summer temperature of 80F and winter temperature of 70F are provided with relative humidity of 47% the year 'round.

The installation is powered by two 10-hp. motors on the condensers and one 3-hp. motor to operate the fans. As no room was available in the building, it was necessary to erect a small structure nearby to house the air conditioning equipment.





(Top) Four-story office building of the Sloss Sheffield Steel & Iron Co. (Below) Three views of the surroundings of the office building which made air conditioning necessary—left, cement mixing plant; center, spray pond; right, busy street and iron furnace.

Bin Feeds for Stokers

By NOEL CUNNINGHAM

THE technique of design and installation of heating stokers has improved tremendously in the last very few years as has the quality of stoker coal and the knowledge of how best to burn the varieties which are available in various localities. Also, as more people use stokers, a greater volume of experience has grown up and new users learn from their acquaintances who have had longer experience. Just as the song, "He had to get under, get out and get under, and fix up his automobile," which was true to life in 1911 is ridiculous today, so with heating stokers, the troubles of only a short time ago just do not occur any more.

And now that the difficulties which loomed so large have gone, one fact which was hardly noticed assumes an importance which few in the stoker business ever expected it would. It is just as hard work to fill a hopper with the best of coal as it ever was with doubtful coal. It seems as if the new stoker users who had none of the sad experiences of the hardy pioneer users resent the regularity with which the hopper demands attention far more than the oldtimer resented all the real hardships that he acquired along with his stoker and coal of other days. It is natural that it should be so—when a mechanism and its accessories approach perfection some little thing that could be fixed and has not been, stands out like a dead fly in an otherwise excellent salad.

Today every considerable manufacturer of stokers is offering or is preparing to offer stoker equipment which feeds direct from the coal bin. The probability is that this arrangement will be standard within the next few years and the hopper feed will be exceptional. An engineer who makes extensive installations of American stokers in England states that he cannot use hopper-fed stokers. If he talks hopper he is countered by the remark: "Why, if I have to shovel coal into a hopper I might as well shovel it into the fire." All his stoker installations are fed automatically direct from the bin.

Bin Feed Not New

Since 1929 one manufacturer has supplied an automatic feed direct from bin. Two models are used, one of which fills the standard hopper. The feed mechanism is provided with its individual motor which operates an inclined screw conveyor extending through a tube from the coal bin floor (or below) to the top of the hopper. When the hopper is full a plate in its lower part is borne down by the weight of the coal above it and cuts the motor circuit. The conveyor is then inactive until the hopper empties sufficiently to allow the control plate to rise and again cut in the hopper feed motor. This device has been entirely successful. Cost to consumer and the fact that it restricts passageway around the stoker have probably prevented more extensive use. It is much in its favor that coal can be conveyed to the stoker from almost any bin position.

Double Screw Conveyor Feed

Another design provides a screw conveyor bin feed arrangement which drives from the stoker gear box and empties downward into the conveyor to the stoker retort (see Fig. 1). The two screws are in synchronized operation and no hopper is used. The screw conveyor from the bin is actuated by a mitre gear from the stoker gear box which allows its being placed at any angle with the coal conveyor leading to the stoker retort. The stoker drive can be set as required to serve the heater without reference to the placement of the coal supply. A disadvantage is that the conveyor from the bin is usually an obstruction as it must be high enough to empty into the secondary conveyor. Also, where stoker and coal bin bottom are on the same level, the primary conveyor is off the floor to an extent which limits its effectiveness in evacuating the coal bin.

Depressed Primary Screw

Another arrangement (Fig. 2) which does not obstruct passageway and which allows a lower placement of the primary conveyor in the coal bin brings the coal delivery from the primary conveyor under the secondary conveyor into which it is extruded upwardly just as the coal is forced up in the retort by the secondary conveyor. The primary conveyor is driven by a ring gear which is carried on the cylindrical portion of the coal tube rising from the primary to the secondary conveyor, the coal thus passing centrally through the gear. The ring gear is driven by a bevel gear in the gear box and drives a second bevel gear which actuates the primary conveyor. This gear can be placed at any point on the circumference of the ring gear so that the primary conveyor can be at any desired angle with the secondary conveyor and bring coal from any coal bin position. In new building construction this is an extremely useful feature as everything is below floor level except the drive and secondary conveyor and the latter can be sunk in the floor if desired by pitting the stoker. However, it would be rather difficultly accessible in case of coal screw blockage and for repairs and renewals. Installation of this device in existing construction requires that a trench be made in the basement floor and, where the length of the conveyor from the coal bin is considerable and the concrete hard, this may be no easy matter.

Single Conveyor

A bin feed which requires a single conveyor, primary, and secondary in one (Fig. 3), is now on the market. This provides a traction drive placed on the side of the heater farthest from the coal bin. There must be alignment of bin, stoker retort, and drive. This is usually easy of attainment with round boilers where the ashpit base casting can be turned so that the screw enters the ashpit door and a hole need be cut only in the back

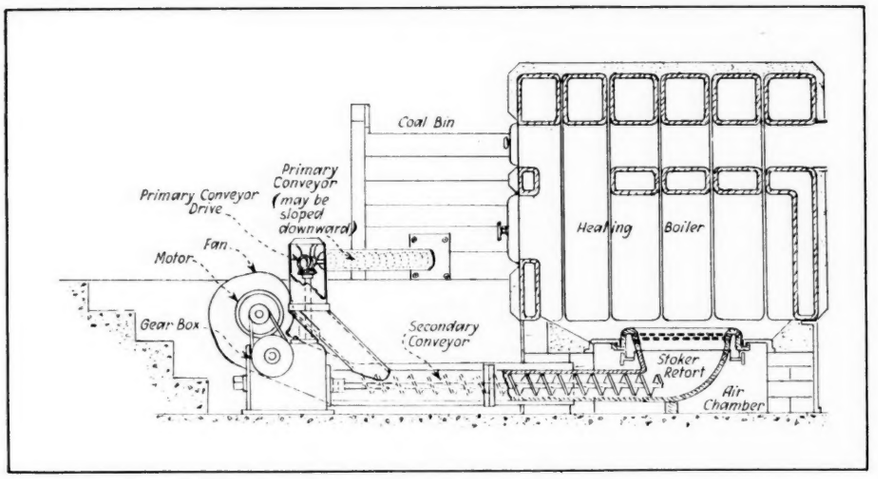


Fig. 1. Screw conveyor, bin feed arrangement driven from stoker gear box and emptying downward into stoker conveyor.

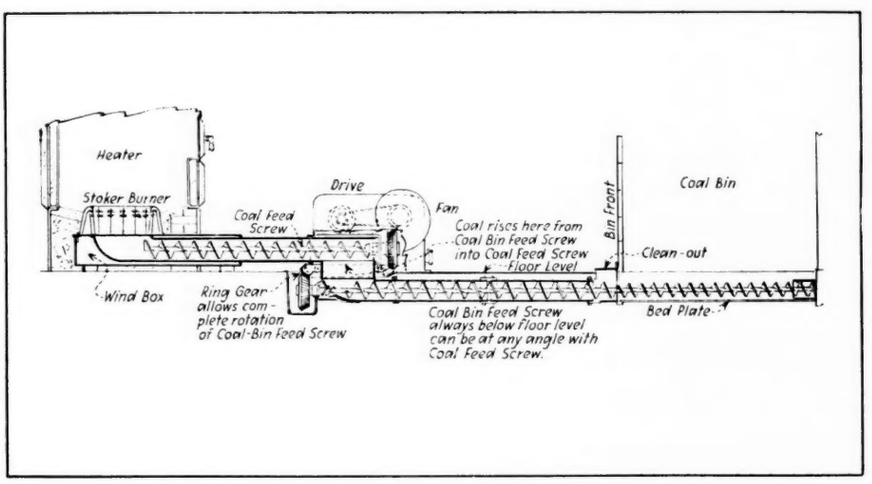

Heater
Stoker Burner
Coal Feed Screw
Drive
Fan
Coal rises here from Coal Bin Feed Screw into Coal Feed Screw
Floor Level
Bin Front
Coal Bin
Clean-out
Wind Box
Ring Gear allows complete rotation of Coal-Bin Feed Screw
Coal Bin Feed Screw always below floor level can be at any angle with Coal Feed Screw.
Bed Plate

Fig. 2. Arrangement which allows a lower placement of primary conveyor. Coal passes through ring gear which drives primary conveyor.

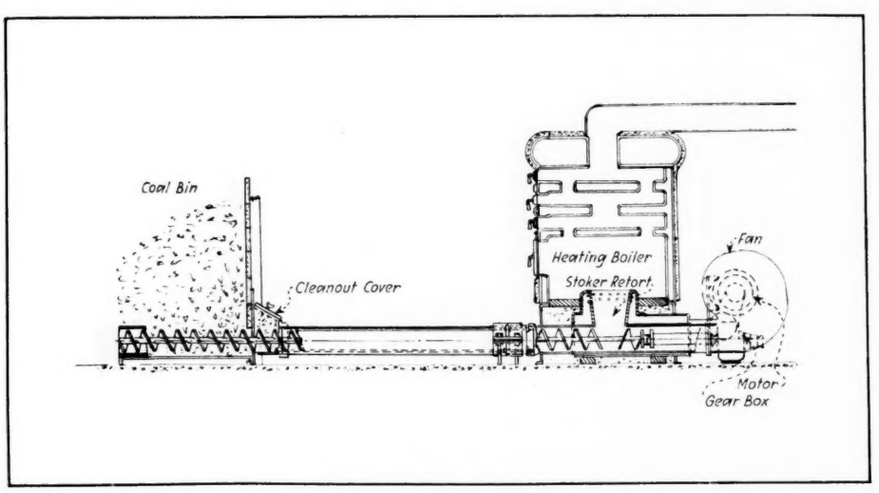


Fig. 3. A bin feed requiring a single conveyor. Bin, stoker retort, and drive must be in alignment.

of the ashpit casting. The double end retort is more expensive than the single opening retort to build and replace and there is the possibility that the portion of screw shaft within the retort may become hot enough during periods when the stoker is not operating so that it will twist up when operation is resumed and power is applied to turn the screw.

Driving Mechanism in Front

Another kind of bin feed stokers uses straight line arrangements which allow placement of the driving mechanism in front of the heater. One which is used more abroad than in this country (Fig. 4) has primary and secondary conveyors on the same level and elevates the coal over the drive gear which actuates the two conveyors. Having the primary and secondary conveyors on the same level permits inexpensive installation, the conveyor tubes being at a height which is not usually objectionable. If it is desirable to carry them below floor level the stoker can be pitted. This arrangement is applicable to all heaters both large and small and to rectangular as well as to round stoker retorts. A disadvantage is that there must be alignment of bin, drive, and stoker. The illustration shows a short screw conveyor to make the transfer from primary to secondary conveyor. This is necessary in the larger capacity stokers. However, for small stokers the cross-over conveyor is eliminated, the coal rising from the primary conveyor over a rounded hump and falling by gravity into the secondary coal conveyor.

Two Motor Drive

From the standpoint of practical application to any shape or capacity of stoker retort or heater the arrangement shown in Fig. 5 is of interest. The two main conveyors are driven each by an individual motor and gear box. The two conveyors are tied together by a coal transit tube expanding in the direction of coal travel. This allows setting the primary conveyor at any angle with the secondary and, as both conveyors are at the same level and close to the floor, there is a minimum of passageway obstruction. By pit-

ting the stoker both conveyors may be carried below floor level. The main stoker drive and the coal feed into the retort are practically identical with the standard hopper design, the hopper being eliminated and the cast iron hopper base being replaced by a casting having a cover which may be turned in any direction required to connect with the transit tube from the primary conveyor. This arrangement is adapted to stokers of 100 lb. per hr. capacity and up. With smaller stokers, cost of operation of two motors is usually considered too large a proportion of total cost.

Interchangeable Feed

A simple design of coal bin feed is shown in Fig. 6. This permits accessibility and placement of the drive ahead of the heater without cutting through the heater ashpit. Its design is such that it is interchangeable with the hopper type and both primary and secondary conveyors are at the same level so that they may be placed either above or below the floor level as may be desired.

Coal Segregation

In conveying coal to heating stokers direct from the bin it is considered essential to limit segregation of the fine coal element. Otherwise there may be considerable periods during which stoker feed is practically all fine or all coarse. As the entire stoker performance changes between these alternations, coal segregation will normally cause irregularity in operation. Sized bituminous coal of low friability is available and should be entirely satisfactory in avoiding this difficulty. However, screenings carrying a limited content of fine element make a desirable stoker fuel both from the standpoint of cost to consumer and coal mining economics.

Oil treatment at the coal mine greatly reduces segregation in shipping, in dealers' yards, and in consumers' bins. It seems probable that screenings oil treated at the mine and modified by partial removal of fine element will prove to be the best fuel for bin-fed bituminous coal stokers.

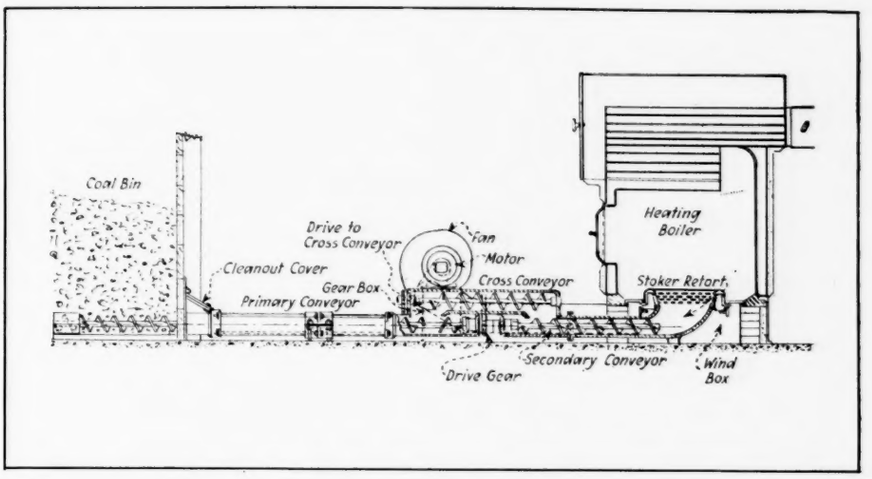


Fig. 4. A straight line arrangement which allows placing driving mechanism in front of boiler. Primary and secondary conveyors are on same level and the coal is elevated over drive gears.

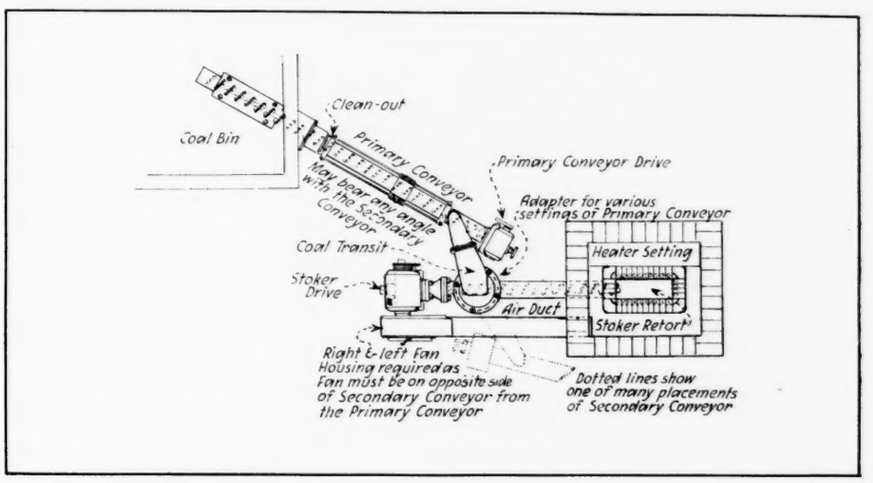

Clean-out
Coal Bin
Primary Conveyor
Primary Conveyor Drive
May bear any angle with the Secondary Conveyor
Adapter for various settings of Primary Conveyor
Coal Transit
Heater Setting
Stoker Drive
Air Duct
Stoker Retort
Right & left Fan Housing required as Fan must be on opposite side of Secondary Conveyor from the Primary Conveyor
Dotted lines show one of many placements of Secondary Conveyor

Fig. 5. An arrangement which allows setting primary and secondary conveyors at any angle with each other. Two motors are used.

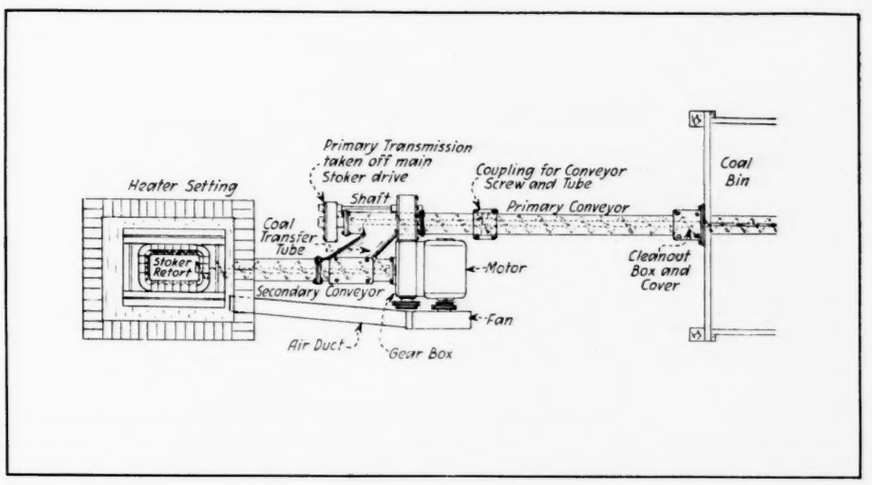


Fig. 6. A simple arrangement with both primary and secondary conveyors on same level. Stoker drive is in accessible position.

Infiltration Through Doors†

AN important source of heat load in summer cooling installations, particularly in commercial establishments, is the infiltration air through doors. Even in stores where the doors are kept open only long enough to allow customers to enter or leave, this heat load reaches a large value, while in stores where the doors are kept open at all times the load becomes very large.

Many engineers have realized this and have called for the installation of such devices as door checks, revolving doors or vestibules with double doors, in an attempt to lower the heat load. Just how successful these devices were was not known until recently when tests were conducted on about 450 entrances in buildings located in a number of cities. The entrances, which were of all types, included hinged doors, hinged doors with vestibules, and revolving doors.

Effect of Wind Velocity and Direction

Many engineers have the impression that the wind has a negligible velocity at times when temperatures and relative humidities are high. Actually a study of the Weather Bureau records in New York shows that the average wind velocity when the wet bulb temperature was 75F or over was 10 m.p.h., while during the entire four summer months it was only 9 m.p.h. Thus, these records seem to indicate that one can expect to have a higher-than-average wind velocity during periods of high humidity.

Studies of actual entrances indicated that in the crowded sections of cities, the wind direction had little bearing on the infiltration or exfiltration through doors. This was due to the pressure areas and eddy currents set up by surrounding buildings. Only in cases where the door faces a large open area, such as a park, will the direction of infiltration be the same as the wind direction. In crowded sections the studies showed that one can always expect to find infiltration or exfiltration in the entrances regardless of wind direction when the wind has a normal velocity.

Infiltration Through Open Doors

In order to determine the infiltration through hinged doors tests were conducted on doors left in an open position to obtain an idea of the velocity of the air flowing through the door. Then a study was made of the time which the door remained open while a person passed through it. By combining these two figures one could then obtain an idea of the amount of air flowing through the opening.

Tests on approximately 250 hinged doors which entered into areas having doors in one wall only showed a mean infiltration velocity of 165 f.p.m. This represents average conditions—during times when the wind has a high velocity or in entrances directly exposed the infiltration velocity would be closer to 250 f.p.m., while in protected doorways or at times when the wind velocity is low the infiltration velocity would be close to 75 f.p.m. With the velocity of 165 f.p.m., a double door (5 ft. wide) would have an infiltration or exfiltration of about 5,800 c.f.m. and a single door would have approximately 3,000 c.f.m.

Doors in More Than One Wall

Approximately 200 tests in entrances to areas having doors in more than one wall showed that the infiltration velocity varied from a minimum of 140 f.p.m. to a maximum of 350 f.p.m. with a mean of 256 f.p.m. This represents a double doorway infiltration of approximately 9,000 c.f.m.

From the above figures the engineer can readily calculate the additional refrigeration capacities needed when the owner of the store wants to leave the doors open. In a store having two double doors, both remaining open, with a mean infiltration or exfiltration velocity of 256 f.p.m. the volume of infiltration would amount to approximately 9,000 c.f.m. If a 12F differential of cooling was maintained, this additional load would require a refrigeration capacity of about 32 tons and not only would this cause a large load on the cooling system but it would also allow a considerable amount of dust to enter. Even though a portion of this infiltration air could be said to supply the ventilation requirements there would still be a large excess load. For instance, assuming that the store housed 200 persons there would still be 5,000 c.f.m. of excess air which would have to be cooled. With a 12F differential of cooling this would require an additional refrigeration of 15½ tons.

Doors Remaining Closed

Tests on approximately 150 single doorways showed that the average effective door opening for single door entrances was approximately two seconds for each person passing through. It should be noted that this was the time of the effective opening and not the total time. The total time was found to be close to six seconds when a door check was used. However, during four seconds of this time it was found that the door was open less than 12 in.

Using the data which have already been given we can now determine the volume of air which enters when a person passes through the entrance. As pointed out before, entrances in only one outside wall can be expected to have an infiltration in the median conditions of 5,800 c.f.m. for double opened doorways and 3,000 c.f.m. for single opened doorways. When the door is open only to permit the people to pass through and the effective opening is two seconds the infiltration volume would be 110 cu. ft. per person passing through the entrance for a double door. Where the entrance opens into an area having doors on more than one outside wall it has been stated that the infiltration volume will be 9,000 c.f.m. for a double open door and approximately 4,500 c.f.m. for a single open door. Where these doors remain closed, a single doorway will have an average infiltration of 165 cu. ft. per passage.

†This article is based on a paper published by the ASHVE, by A. M. Simpson and K. B. Atkinson, entitled "The Infiltration Problem of Multiple Entrances," and a paper published by the ASRE, by A. M. Simpson entitled "Infiltration Characteristics of Entrance Doors."

TABLE 1.—INFILTRATION THROUGH ENTRANCES
(Doors in One Wall Only)

No. of Passages Per Hr. Up To	Single Swing Doors		Swing Doors—Vestibule		Revolving Doors	
	Infiltration Per Passage Cu. Ft.	Heat Gain Per Passage Per Degree Temp. Dif. B.t.u.	Infiltration Cu. Ft. Per Passage	Heat Gain B.t.u. Per °F Per Passage	Infiltration Cu. Ft. Per Passage	Heat Gain B.t.u. Per °F Per Passage
100	110	1.98	83	1.49	30	0.54
200	110	1.98	83	1.49	30	0.54
300	110	1.98	83	1.49	30	0.54
400	110	1.98	83	1.49	29	0.52
500	110	1.98	83	1.49	29	0.52
600	110	1.98	82	1.47	28	0.50
700	110	1.98	82	1.47	27	0.49
800	110	1.98	82	1.47	26	0.47
900	109	1.96	82	1.47	25	0.45
1000	109	1.96	82	1.47	24	0.43
1100	109	1.96	82	1.47	23	0.41
1200	108	1.95	82	1.47	21	0.38
1300	108	1.95	82	1.47	19	0.34
1400	108	1.95	81	1.46	18	0.32
1500	108	1.95	81	1.46	17	0.31
1600	108	1.95	81	1.46	16	0.29
1700	107	1.93	81	1.46	15	0.27
1800	105	1.89	80	1.44	14	0.25
1900	104	1.87	80	1.44	13	0.23
2000	100	1.80	79	1.42	12	0.22
2100	96	1.73	79	1.42	11	0.20

Entrances with Vestibules

Studies were made of more than 200 vestibule entrances to determine the effective time of a direct draft opening in the vestibule. This was found to be 1½ seconds for each person passing through the entrances. In other words, the vestibule gives only 25% better protection than a single swing door. This is due to the fact that the flow of traffic is often such that both doors are opened at the same time by persons passing in and out. An entrance having a vestibule, when opening into an area having doorways in more than one outside wall, was found to have an infiltration volume of 128 cu. ft. per person.

Infiltration Through Revolving Doors

A revolving door is so constructed that it seals the entrance against any free flow of air. The only infiltration through a revolving door is due to the air displaced as it revolves. The factors which govern this displacement of air by a revolving door are, 1—speed of rotation of the door, 2—scavenging effect of air currents directed towards the compartments of the door, 3—differences in temperature between the interior and exterior which set up vertical circulation of air in each compartment, 4—number of revolutions per person passing through it.

It was found that the normal operating speed of a

TABLE 2.—INFILTRATION THROUGH ENTRANCES
(Doors in More Than One Wall)

No. of Passages Per Hr. Up To	Single Swing Doors		Swing Doors—Vestibule		Revolving Doors 6 Ft. x 7 Ft.		Revolving Doors 7 Ft. x 7 Ft.	
	Infiltration Cu. Ft. Per Passage	Heat Gain B.t.u. Per °F Per Passage	Infiltration Cu. Ft. Per Passage	Heat Gain B.t.u. Per °F Per Passage	Infiltration Cu. Ft. Per Passage	Heat Gain B.t.u. Per °F Per Passage	Infiltration Cu. Ft. Per Passage	Heat Gain B.t.u. Per °F Per Passage
100	168	3.02	125	2.25	36	0.65	48	0.86
200	168	3.02	125	2.25	36	0.65	48	0.86
300	168	3.02	125	2.25	36	0.64	48	0.86
400	168	3.02	125	2.25	35	0.63	47	0.85
500	168	3.02	125	2.25	35	0.62	46	0.83
600	168	3.02	125	2.25	34	0.61	45	0.81
700	168	3.02	125	2.25	32	0.58	43	0.78
800	168	3.02	125	2.25	30	0.54	41	0.74
900	168	3.02	125	2.25	28	0.50	39	0.70
1000	168	3.02	125	2.25	26	0.47	36	0.65
1100	168	3.02	125	2.25	23	0.42	33	0.59
1200	168	3.02	125	2.25	21	0.38	30	0.54
1300	168	3.02	125	2.25	20	0.36	28	0.50
1400	168	3.02	125	2.25	19	0.34	25	0.45
1500	168	3.02	125	2.25	17	0.31	23	0.41
1600	167	3.01	125	2.25	15	0.27	21	0.38
1700	163	2.93	124	2.23	14	0.25	19	0.34
1800	159	2.86	122	2.20	13	0.23	18	0.32
1900	156	2.81	120	2.16	12	0.21	17	0.30
2000	152	2.74	118	2.12	11	0.20	16	0.29
2100	147	2.64	115	2.07	10	0.18	15	0.27

TABLE 3.—ENTRANCE PASSAGES PER OCCUPANT PER HOUR FOR VARIOUS TYPES OF BUILDINGS

Banks	8	Department stores	8
Barber shops	4	Furriers	3
Brokers' offices	8	Lunchrooms	6
Candy & soda	6	Men's shops	4
Cigars & tobacco	25	Office buildings	2
5 & 10c stores	12	Public buildings	3
Dress shops	3	Restaurants	3
Drug stores	8	Shoe stores	4

revolving door is between 12 and 14 r.p.m. This is determined by the normal rate of walking. The number of revolutions per person passing through a revolving door in fairly good condition was found to be approximately four-tenths of a revolution per person. Tests on one door which was 7 ft. in diameter and 7 ft. high indicate that there were 46 cu. ft. of displacement per revolution and 18½ cu. ft. per person.

All of the data collected from these tests have been summarized in Tables 1 and 2. Table 1 gives the infiltration through entrances when the doors are in one wall only. Table 2 gives the same information for buildings having doors in more than one wall. In the first column under each type of door, the actual infiltration in cubic feet per passage is shown, while the second column shows the additional heat load in B.t.u. caused by the entrance of this air. It is interesting to note that the infiltration per passage through spring doors is not proportional to the number of passages per hour but remains practically constant to about 1,600 passages per hour. Above this figure it decreases rapidly. The reverse is true for revolving doors—the infiltration decreasing steadily with increased number of passages.

An important factor in determining the infiltration through entrances is the number of passages through a door in an hour. The figures shown in Table 3 are based on actual counts of persons entering and leaving various types of buildings. The top line gives the number of entrance passages per hour to be expected with the corresponding comparison for each type of business. These entrance passages per hour are based on one count for each movement. Thus, one person entering and leaving a store would cause two entrance passages.

Hay Fever Sufferers Relieved by Air Conditioning

IN a report issued by Dr. E. L. MacQuiddy, assistant professor of medicine, University of Nebraska's College of Medicine, appears a discussion on hay fever relief by air conditioning. Dr. MacQuiddy conducted an experiment with three different types of air conditioning equipment. First was a complete, year 'round conditioning unit. Second was a smaller unit which cooled, dehumidified, washed, and circulated the air. Third was a cooling and circulating machine, only.

Pollen, bacteria, and spore counts, temperature and relative humidity readings were carried out for the entire summer. The pollens found at the time of the study were ragweeds and burweed marsh elder. Table 1 illustrates the results insofar as the pollen grains per square centimeter per 24 hr. are concerned.

TABLE 1

Date	Room One	Room Two	Room Three	Hall	Outside
Monday	3	6	9	30	150
Tuesday	5	9	10	140	246
Wednesday	3	4	9	98	196
Thursday	4	3	4	33	132
Friday	4	4	3	57	207
Saturday	3	6	23	81	267
Sunday	5	8	19	51	126

Room 1 had the complete, year 'round conditioner unit; room 2, the smaller, summer only, conditioner; room 3, the cooling and circulating unit; the hall, none.

The conclusion Doctor MacQuiddy reached, according to an article of his published in the May issue of "Hospitals," was "Patients suffering from hay fever and pollen asthma obtained sufficient relief to indicate that air conditioning will become an important adjunct to other means of therapy." He also added, "Air filtration obtained by the methods studied was satisfactory."

The benefits of air conditioning to hay fever sufferers were first discovered when the theaters adopted air conditioning on a nationwide scale.

This report of Doctor MacQuiddy, however, is the first authenticated study of the pollen content by a research physician.

Table 1 indicates that even a cooling and circulating machine makes an appreciable inroad on the pollen content of the air. This is partially due to the closed room. Partially due to the manner in which the air is cooled. The variations, it will be noticed, are much more marked in a room served by the cooler than in those rooms completely conditioned.

The variation in the two rooms that are both conditioned is traceable to the differences in the machines. The second machine is not as large a unit as the first. However, it is obvious that the reduction of pollen content in either model is sufficiently low to give the hay fever sufferer practically complete relief, as compared with the outdoors or even the hall, inside.

Doctor MacQuiddy relates his studies of individual cases which were put in the conditioned rooms. Of twelve closely observed, eight cases showed marked improvement within a matter of a few hours. One case was reported "slight improvement," and one, "little clinical improvement, but felt markedly better." Two showed no signs of any real improvement in their condition. Doctor MacQuiddy concluded, "the relief obtained was in a large measure due to the absence of pollen in the air.

Ten cases of asthma were also studied, and eight, according to Doctor MacQuiddy, "were improved during the time they were in the air conditioned rooms." It must be noted, of course, that practically the entire group of asthma sufferers had "pollen asthma."

From these studies, it is apparent that air conditioning can be used advantageously in the relief of most hay fever, and in the relief of certain types of asthma. —*The Business Conditioner,* Air Conditioning Bureau of Omaha.

Welded Pipe Joint Design Fundamentals

JOINT design involves both the weld cross-section and the form of the joint or fitting which is welded. The design of the weld cross-section, which in addition to the weld metal includes pipe material immediately adjacent, determines whether the weld will be as strong as, or stronger than, the pipe material in case it is stressed to destruction. The design of the entire joint or fitting in turn determines whether the connection will withstand the same stresses as the pipe itself.

It is the purpose of this article to consider in some detail the factors involved in the design of the weld cross-section.

The Butt Type Weld

The theoretical strength of the simple butt type weld in wide use for pipe joints requires little discussion since the weld merely *replaces* a portion of the pipe wall cut away, becoming an integral part of the pipe itself. It is easy to show that the butt type weld, by its very nature, provides the strongest and soundest joint obtainable with a given amount of weld metal.

The open butt type joint is the standard line joint and is recommended for all commercial thicknesses of pipe, from lightweight tubing to thick walled pipe for power plant service, for all services and pressures to which steel and wrought iron pipe are subjected. This recommendation applies as well to joining welding fittings to each other or to ends of pipe.

Reasons why the open butt type joint is the standard line joint are primarily: (1) its 100% joint strength, (2) its simplicity and (3) the ease with which it is made.

In repair work, as in new installation, the open butt type joint makes possible a method of construction having remarkable flexibility. Sections of a piping system to be replaced can be removed with the cutting blow-pipe, and a new section or fabricated piece welded back in place. This is done without disturbing in any way the pipe on either side of the cuts, often with greater ease than when replacing a flanged valve or fitting.

Requirements in Weld Design

Design of welds involves consideration of the requirements of base metal preparation and weld cross-section. Both are shown in Fig. 2, standard weld design for line joints. It will be seen that base metal preparation for wall thicknesses 3/16 in. and over is simply the beveling of the metal edges to an angle of 25° to 45°, which forms a vee to be filled in by welding. For wall thicknesses less than 3/16 in. beveling is unnecessary because it is possible to secure fusion at the bottom of the joint with edges left square. A skillful operator can obtain good fusion on slightly thicker pipe with edges square, but welding is slower and more gases are consumed.

Angle of Bevel. The angle of bevel depends principally on the welding technique used. Experience has shown that a 60° to 70° vee gives best results when the backhand technique and a single flame is used. With multi-flame welding, a vee of 50° to 60° has been found to be satisfactory and more economical on pipe thicknesses 5/16 in. to ½ in. Likewise, best results with neutral flame welding and forehand technique are obtained with a 90° vee. It is fundamental that the expense of welding varies directly with the amount of welding rod deposited, hence a narrower vee—when allowed by the technique employed—means a lowered cost of welding for a particular pipe wall thickness.

Joint Spacing. In the designs in Fig. 2, provision is made for a gap or spacing between the metal edges, usually between 1/16 in. and ⅛ in., during the welding operation. Primarily, the spacing facilitates thorough fusion of the weld metal with the pipe metal at the bottom of the vee. Some have the mistaken idea that this gap allows weld metal to sag within the pipe, but this is definitely not the case.

With the single vee weld, a sloping puddle of weld metal narrowing to a point at the front is employed. This permits the bottom of the vee to be welded together slightly in advance of the upper portions in the following manner: As the edges of the pipe at the bottom of the vee become molten, the advancing, shal-

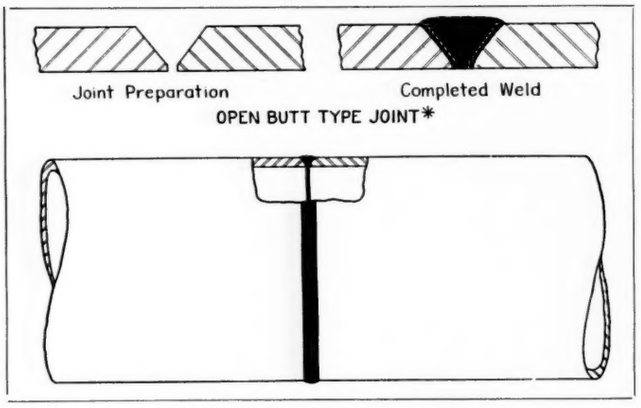


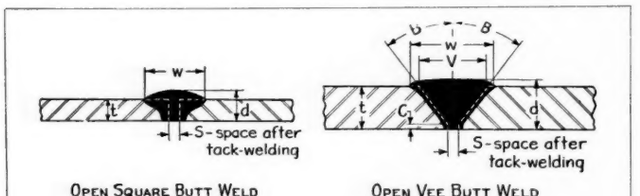
Fig. 1. The open butt type joint for pipe service.

low front of the welding puddle bridges across between the edges, fusing them together. Surface tension of the molten metal prevents it from sagging inside the pipe and it solidifies almost immediately as the puddle advances, providing support for the more fluid metal in the center of the puddle. The open square butt type weld is made in a similar manner.

If the spacing is greater than 1/8 in. during welding, bridging at the bottom of the vee is aided by the end of the welding rod. This helps to keep the puddle less molten at that point and provides support by cohesive action. Since wider spacing requires extra rod manipulation and increases the cross-section of the weld, it is desirable in the interests of economy to hold the spacing to approximately 3/32 in. at the point of welding.

Tack-Welds. The spacing and joint alignment are controlled by tack-welds—shallow welds about 1 in. long—made at intervals around the joint before welding is commenced. The tack-welds contract about 1/16 in. upon cooling, which means that the original spacing must be 5/32 in. to 3/16 in. or more. As welding is started and progresses around the joint, the space ahead closes slightly due to contraction of the weld. The space would close entirely but for the tack-welds, so they are made at sufficient intervals to keep the spacing from becoming less than 1/16 in. at any point. This permits gases from the flame to pass inside the pipe joint, facilitating welding of the vee bottom.

Weld Cross-Section. Reference to Fig. 2 will show that weld cross-section for butt type welds is largely determined by preparation and spacing of the pipe ends. Theoretically, when a welding method is employed assuring weld metal stronger than the base metal, the weld need only fill in the gap or vee between the pipe ends. However, a minimum reenforcement of 10% in the case of single vee welds is specified because a truly flush weld is less easy to produce. The reenforcement also adds a slight factor of safety.



STANDARD WELD DESIGN FOR LINE JOINTS

Welding Method	t	Bevel, B	Shoulder, C	Spacing, S	Weld Depth, d	Weld Width, w
Single-Flame Lindewelding Neutral-Flame Welding	under 3/16"	no bevel	-----	1/16" to 3/32"	1.2t to 1.5t	2t to 3t
Neutral-Flame Welding	3/16" & up	35°-45°	1/16" ± 1/32"	3/32" to 3/16"	1.1t to 1.3t	V + 1/8" to 3t
Single-Flame Lindewelding	3/16" to 1/2"	30°-35°	1/16" ± 1/32"	1/16" to 1/8"	1.1t to 1.3t	V + 1/8" to 2 1/2 t
Multi-Flame Lindewelding *	3/16" to 1/4"	30°-35°	1/16" ± 1/32"	1/16" to 1/8"	1.1t to 1.3t	V + 1/8" to 2 1/2 t
Multi-Flame Lindewelding *	5/16" to 1/2"	25°-35°	1/16" ± 1/32"	1/16" to 1/8"	1.1t to 1.3t	V + 1/8" to 2 1/2 t
Single Or Multi-Flame Multi-Layer Lindewelding	9/16" & up	30°-35°	1/16" ± 1/32"	3/32" to 5/32"	1.1t to 1.2t	V + 3/16" to 2 1/2 t

Fig. 2. Standard weld design for line joints as revised to incorporate new techniques.

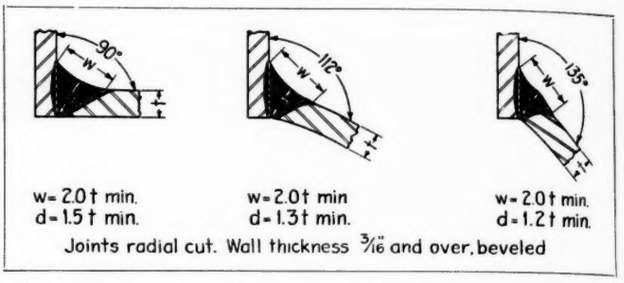


Fig. 3. Design of inside corner welds on branch connections.

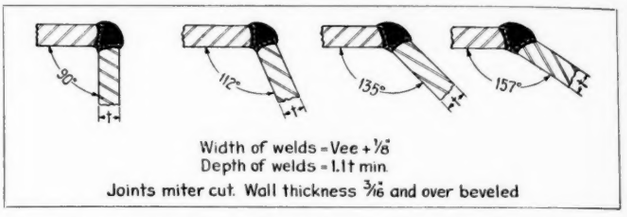


Fig. 4. Design of outside corner welds on turns.

When the weld metal has a lower unit tensile strength than the base metal—as when a low carbon steel or iron welding rod is used for welding low carbon steel pipe—reenforcement is necessary to insure a joint as strong as the pipe. A minimum reenforcement of 25% is usually specified. Reenforcement in excess of 25% does not add to the strength of the joint, unless the weld is increased sufficiently in width to maintain the slightly convex contour, an undoubtedly uneconomical practice.

Minimum weld width is set at the lowest dimension practicable with the welding operation. A width somewhat larger than this indicates excessive melting of the base metal, and while not necessarily detrimental to weld quality, it shows inefficient welding and is to be discouraged.

Penetration of the weld into the pipe ends, beneath the surfaces of the vee, depends largely on the welding technique employed. With certain types of welding, it is quite possible to produce welds having no *noticeable* penetration whatever, yet with perfect fusion between weld metal and base metal. This is not generally the case, however, and penetration of 1/32 to 1/16 in. with still more at the upper and lower edges of the vee

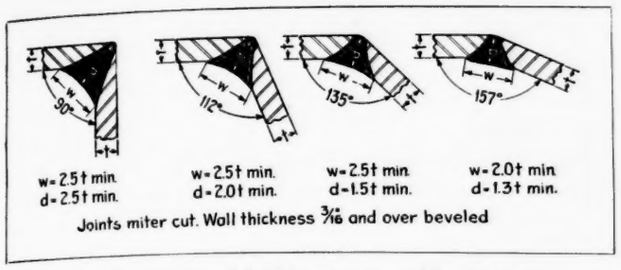


Fig. 5. Design of inside corner welds on turns.

is the normal result in ordinary practice. When welding with forehand technique, penetration of from 1/8 to 1/4 in. is the usual result. Excessive penetration is needless and represents a waste of time and gases.

Inside and Outside Corner Welds

Welded turns, welded branch connections, and certain other types of welded fittings (Figs. 6 and 7) contain what are known as corner welds, a variation of the butt type weld. (See Figs. 3, 4, 5, and 6.) A similarly economical use of weld metal is made in the design of these welds which develop the full wall thickness of the pipe joined, are regular in contour, and are produced with a welding technique very similar to that used for butt type welds. Considerations of joint preparation and weld cross-section are also essentially the same.

Beveling. Wall thicknesses 3/16 in. and over should

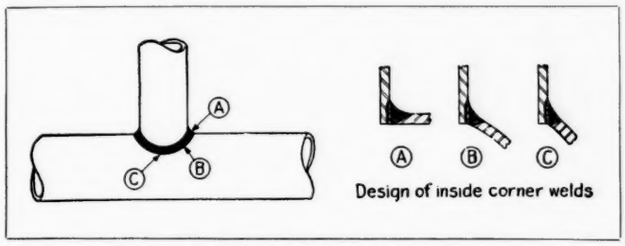


Fig. 6. A typical welded tee showing use of corner welds.

be beveled to give a vee of 70° where possible. With inside corner welds, where pipe walls meet at an angle of 90°, as shown at the left in Figs. 3 and 5, a vee of from 45° to 60° is the widest that is generally practicable.

Weld Dimensions. As a guide to the minimum amount of metal in the weld, the minimum dimensions of the weld expressed in terms of weld width and depth are given in Figs. 3, 4, and 5.

In the case of a header and branch of equal diameter the minimum dimensions of the weld vary from a width of 2 times the header wall thickness and a depth or throat of 1.5 times the header wall thickness where the pipe edges intersect at 90°, to that where the pipe edges are in line on the side and a butt type weld is made having a minimum width of the vee plus 1/8 in. and a minimum throat 1.1 times the branch wall thickness. For branch and header of unequal diameter the weld dimension will vary within the above range, being a minimum of 2 and 1.5 times the header wall thickness for the width and depth respectively at the top and slightly less at all other points.

Fillet Welds

Fillet welds, several types of which are shown in Fig. 8, are used in connection with certain welded joints, and for welding on reenforcements such as pads and saddles. They are also used in piping systems as structural welds for joining anchors and supports to pipe and structural members. Fillet weld design for pipe joints and fittings is somewhat similar to the design of butt type welds. For structural purposes, however, quite different methods of design are in general use.

Strength. Fillet welds are utilized in resisting forces both in tension and in shear. At *A*, Fig. 8, for example, fillet weld *a* at the end of the upper bar is in tension under load, and fillet weld *b* is in shear. With these

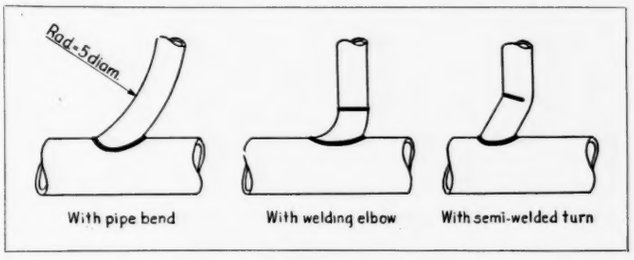


Fig. 7. Welded sweep tees.

two welds having proper cross-section and length, the entire load which the upper bar is capable of carrying can be transmitted to the lower plate.

At *B*, Fig. 8, fillet weld *c*—in tension—can likewise transmit the entire load from the upper bar to the lower plate. This assumes that the weld metal is equal to or greater than the base metal in unit tensile strength. The assumption must also be made in the case of both *A* and *B* that during loading the bar and plate remain in full contact *since appreciable bending in base metal parts near a fillet weld reduces the strength of the joint.*

The total strength of a fillet weld in shear or tension depends on three factors: (1) the throat (*d*); (2) the length of the weld; and (3) the unit strength of the weld metal in shear or tension, depending on which type of stress is being considered. Tests have shown that the unit strength of fillet welds in tension at the throat is equal to the unit strength of butt type welds in ten-

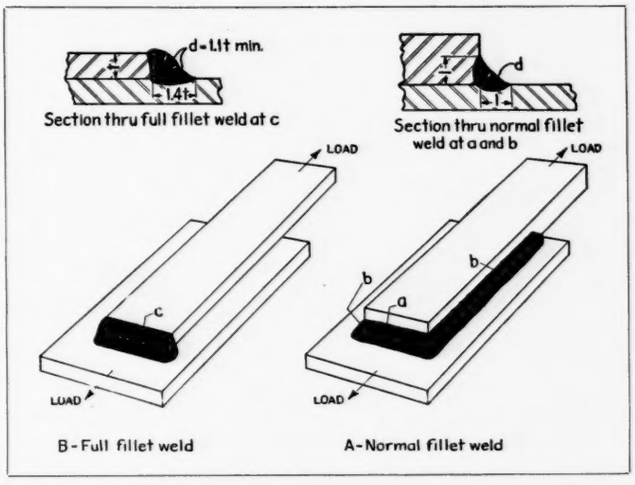


Fig. 8. Design of fillet welds.

sion; that in shear the strength of fillet welds is approximately 87% of their strength in tension; and that fillet welds in tension combined with fillet welds in shear (as in Fig. 8, *A*) also develop about 87% of their strength in tension alone. This latter figure is somewhat conservative but is justified by the less ideal design of the fillet weld as compared to the butt type weld.

Fillet Weld Design for Pipe Fittings

Pipe fitting reenforcements such as saddles, rings, or pads are joined to the pipe with fillet welds.

The normal fillet weld is more economical to make for equivalent strength, and is used where the full tensile strength of the reenforcing piece need not be developed, or where a sufficient length of normal fillet can be placed in both tension and shear to develop full strength of the top piece, as in *A*, Fig. 8.

Full Fillet Weld. This is shown in cross-section at the top of Fig. 8. It is evident that this weld is suited to one particular purpose, that of transferring the tensile stress from the upper of two parallel plates in close contact, to the lower. Whether the plates are flat, or curved as in the case of pipe, is of little consequence.

The shape of the cross-section is determined by practical considerations. In other words, the cross-section shown for the full fillet has been found to have the smallest dimensions that will develop the full tensile strength of the upper plate, where the unit tensile strength of the weld metal is equivalent to or greater than that of the base metal. As with the butt type weld, the throat *d* should be increased to 1.25t if low carbon rod is used on ordinary low carbon steel plate, to provide a minimum reenforcement of 25%.

Normal Fillet Weld. The cross-section of the normal fillet is almost always in the shape of a right triangle, and, other factors being constant, its strength is determined by the length of the throat *d* as explained previously. For other than right triangles, the throat *d* is the shortest distance from the root to the face of the weld—the face being the part of the weld that is seen. If the weld is reenforced, that is, if the face is rounded or convex, the weld is given additional strength in shear, equivalent to the lengthening of *d*, but little or no strength is added if the weld is in tension. To make reenforcement effective in tension, the lower leg *l* would have to be increased to 1.3 times the upper leg *l* (the leg at the end of the upper plate) so as to resemble the full fillet.—*Abstracted from Oxy-Acetylene Tips.*

Russia Plans Huge Network of Heat, Power Stations

THE third Five-Year Plan will see development on a large scale of district power stations which supply not only electricity, but hot water for domestic and industrial heating purposes. The water will be obtained by utilizing the steam from the turbines on the way to the condenser, a valuable source of energy which in ordinary power stations simply runs to waste. A considerable start has already been made in the construction of these stations, but during the third Five-Year Plan period, all steam-driven power stations constructed will supply both electricity and heat.

These plans raise a number of interesting and important technical problems, which are dealt with in a recent issue of "Za Industrializatsiu," organ of the Peoples Commissariat of Heavy Industry. Transport is the first question. The general plan for the central heating of Moscow has already shown that there would be considerable difficulty in delivering fuel to the large heat and power stations with output of 700,000 to 1,000,000 kw. The new stations would have to be planned for the suburbs in order to make possible the construction of large buildings for storage of fuel, for purifying the smoke, etc.

Additional difficulties arise through the necessity of bringing in daily more than 1,500 carloads of coal from the Moscow coal fields and shipping out about 500 cars of ash. Such heavy traffic could not be brought into the center of the city. Clearly, many of these difficulties would be overcome by burning gas instead of solid fuel. Both Leningrad and Moscow have fairly close at hand low-quality fuels (coal, shale, peat, etc.), which could be gasified and transported through pipes to the power stations. True, such gasification is expensive and would require a large capital outlay. But for Leningrad and Moscow, considerations of hygiene, transport, and convenience may outweigh the cheapness of burning the fuels directly under the boilers.

Natural gas also promises to be a great source of fuel. Last year for the first time, calculation was made of the country's resources of gas. They were estimated at 986,000 million cubic meters of high calorific value gas. Intensive work is also being carried out to utilize another potential source—underground gasification of coal. This is being accomplished already on a small scale and may bring about a revolution in the technique of heat and power supply.

With the utilization of gas, it will become inexpedient to build gigantic structures outside the cities and transmit heat for long distances. Each heat and power station can be built in the center of a district which it will supply by comparatively short feeders. The freedom this will give in choosing the sites for stations will make possible their rational distribution.

The changeover to gas heating will involve considerable improvement and cheapening of the heat and power stations. Gas-fired stations in the various districts of a city will be compact and clean. The boiler and engine rooms, possibly in one building, and the housing for the electrical equipment are all the buildings needed.

A New Service—Up-To-Date Degree-Day Reports for 48 Cities

The table below gives degree-day figures for September for 48 important cities. These figures are preliminary, based on wired reports from these cities, accurate to within a few per cent, so that the reader no longer need wait an additional thirty days for degree-day data. These preliminary tables for the preceding month will appear in each issue of HEATING & VENTILATING during the heating season; the following issue will contain the final, corrected figures for permanent records.

With this issue HEATING & VENTILATING begins its ninth year of publishing monthly degree-day data for important cities of the United States. This service was begun originally for nine cities and has now grown until last year figures were being published for 63 of the more important large cities.

Some of the usefulness of these figures as published was lost in the past due to the length of time which elapsed between the close of the month and the publication of these figures in HEATING & VENTILATING. This publication reaches its readers in the first few days of each month and when it goes to press, prior to that, complete and fully corrected figures for the month just closed are not available.

To overcome this delay, HEATING & VENTILATING is inaugurating with this issue a new service whereby in each issue will appear the number of degree-days for 48 cities for the preceding month as wired to us from these cities. Since these figures will not be quite identical with those as based on final data issued by local weather bureaus, they will be published as "preliminary" degree-day figures and the final, completely corrected figures will appear in the following issue of HEATING & VENTILATING. A trial of this method last spring indicated that the preliminary figures will be not more than 2% in error as compared with the final data.

In some cases it has not been possible to receive these wired reports from the identical cities for which HEATING & VENTILATING is now publishing degree-day data so that the number of cities covered by the new service is somewhat smaller than the number of cities for which final figures are published.

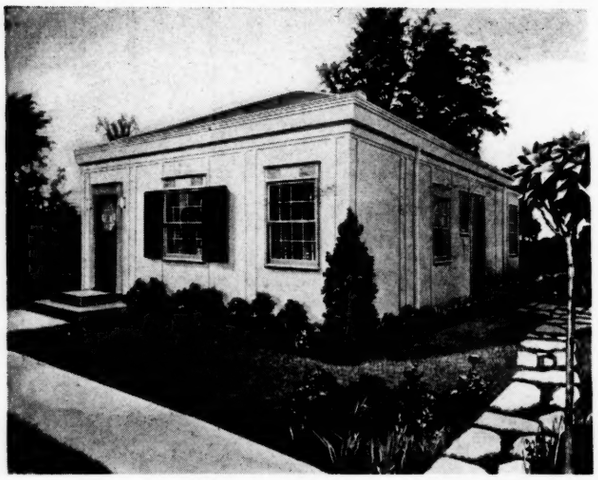
With this arrangement readers will find in their November issue, for example, preliminary degree-day figures for 48 cities for the month of October and in the same issue they will find the final figures for 63 cities for the month of September. The preliminary figures will be accurate enough for most practical purposes but the final figures should be those entered into permanent records.

In view of the shortness of time between the close of the month and the time at which HEATING & VENTILATING goes to press there will not be sufficient time to include the comparative figures with the preliminary data. These comparative figures will appear, as they have in the past, on the page devoted to the final figures in the following issue.

Number of Degree-Days for September, 1936 for 48 Cities—Preliminary Figures

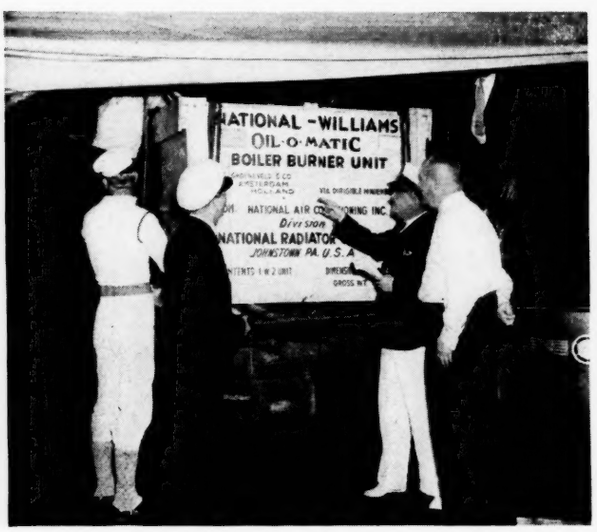
Albany, N. Y.	96	Little Rock, Ark.	2
Atlanta, Ga.	0	Los Angeles, Calif.	0
Baltimore, Md.	25	Memphis, Tenn.	6
Birmingham, Ala.	0	Milwaukee, Wis.	87
Boston, Mass.	118	Minneapolis, Minn.	106
Buffalo, N. Y.	116	Nashville, Tenn.	4
Cheyenne, Wyo.	206	New Haven, Conn.	74
Chicago, Ill.	76	New Orleans, La.	0
Cincinnati, Ohio	55	New York, N. Y.	46
Cleveland, Ohio	80	Oklahoma City, Okla.	44
Columbus, Ohio	53	Omaha, Neb.	83
Denver, Colo.	148	Philadelphia, Pa.	35
Des Moines, Iowa	73	Pittsburgh, Pa.	69
Detroit, Mich.	105	Portland, Me.	176
Dodge City, Kan.	84	Portland, Oreg.	77
Duluth, Minn.	215	Richmond, Va.	15
El Paso, Tex.	35	St. Louis, Mo.	29
Erie, Pa.	82	Salt Lake City, Utah	158
Evansville, Ind.	19	San Francisco, Calif.	105
Fort Wayne, Ind.	83	Scranton, Pa.	88
Grand Rapids, Mich.	114	Seattle, Wash.	155
Harrisburg, Pa.	53	Spokane, Wash.	180
Indianapolis, Ind.	68	Washington, D. C.	29
Kansas City, Mo.	53	Wichita, Kan.	58

PICTURE

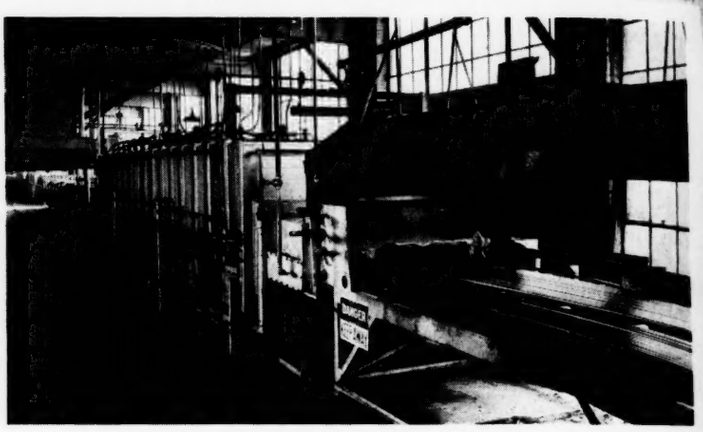


20TH CENTURY HOME, precision-built by the Harnischfeger Corp., Milwaukee, sells for less than $4,000 erected, and has six rooms and bath (Left). Steel framing and trusses give it structural strength. House is heated with a forced warm air conditioning system.

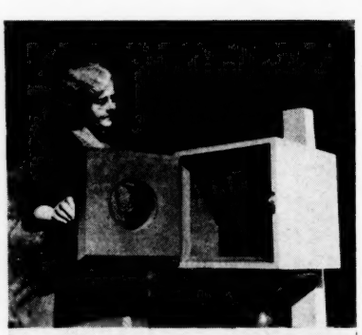
CONTROLLED-ATMOSPHERE tube annealing furnace, electric, recently installed by Steel and Tubes, Inc., Republic Steel subsidiary, for normalizing steel tubing. (Below)



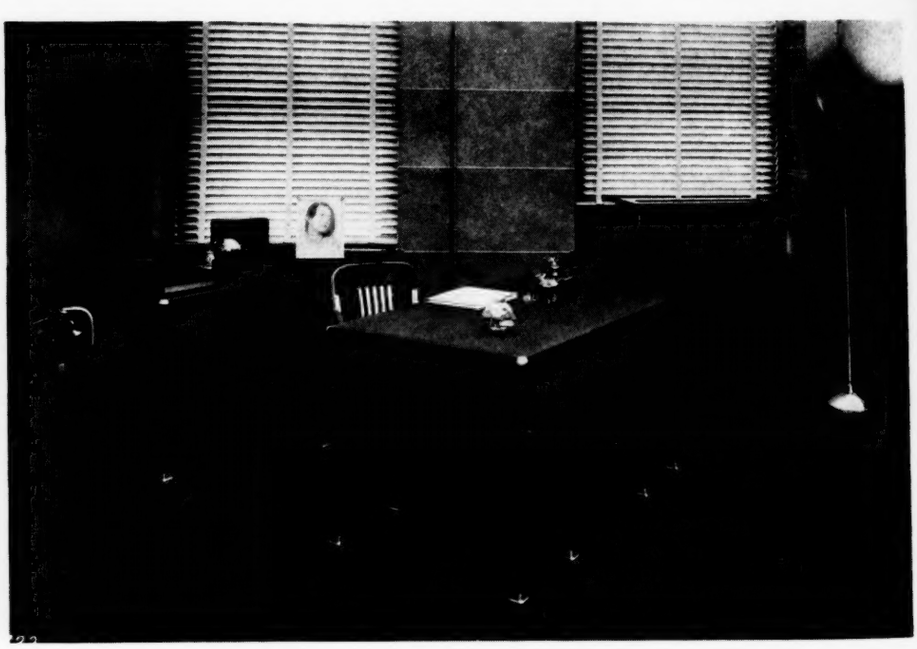
BOILERS VIA ZEP. On a recent trip, the German airship Hindenburg carried a complete oil burning unit weighing 1,162 lb., and made by National Air Conditioning, Inc., from Lakehurst, N. J., to Frankfort-On-Main. The consignment was for Amsterdam. The boiler was suspended throughout the trip from the tackle which lifted it off the ground.



THE CORRECT OFFICE. (Below) An exhibition of the last word in business offices was held in Indianapolis recently. Among other features of the office was a 7-ton capacity room air conditioning unit. Display was sponsored by the Electric League of Indianapolis.



CANARY SINGING SCHOOL. A San Francisco woman teaches canaries to whistle and sing. After listening to phonograph records, birds are placed in these soundproof boxes which have a tiny ventilating system for supplying fresh air to the birds. Insulated hot water pipes passing through the boxes supply enough heat to maintain them between 68F and 70F.



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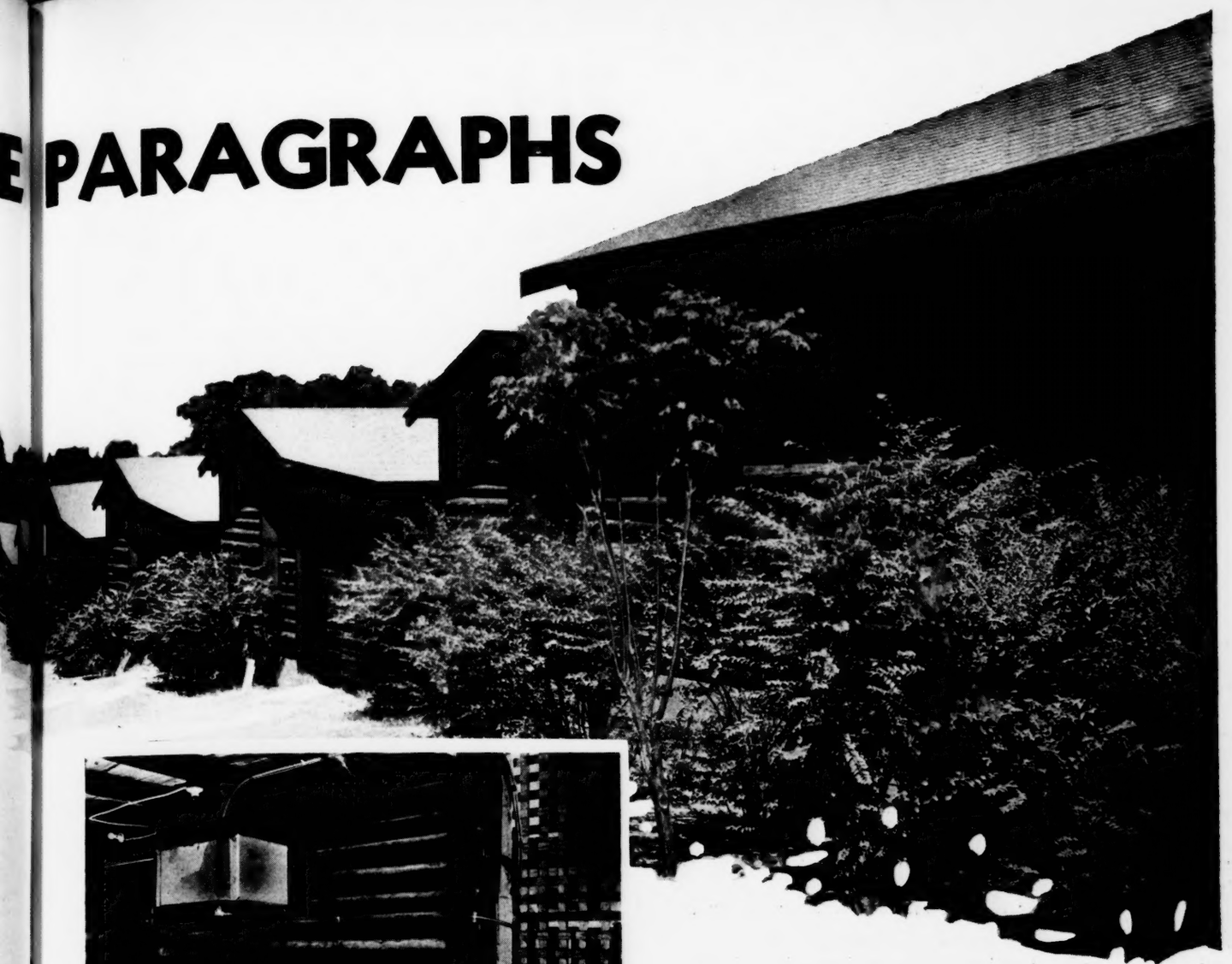

AIR CONDITIONING FOR TOURISTS. These cabins in an Augusta, Ga., touring camp rent at a dollar premium because they are cool and comfortable as a result of being air conditioned. To the left is shown the Kelvinator cooling unit in one of the cabins. The condensing units are housed in a separate building in the rear of the camp.

STOKER EXECUTIVES MEET. Heating stoker sales increased from 936 in July, 1933, to 5,952 in July, 1936. Above are shown some of the key men in the Iron Fireman organization concerned with pushing this sales curve still higher; photo taken at Atlanta where one of the 19 summer district meetings was held. Left to right: Hal Krayenhof, Automatic Coal Burning Corp.; Ray Harlow, Dale Wylie, Ernest Webb, C. T. Burg, W. E. Gleeson, L. R. Teeple Co.; Joseph R. Gerber, Gerber & Crossley, Inc., and Wilbur Kelly.

Insolation†: Its Quantity and Variations

By HERBERT BISHOP ADDINGTON‡

UPON every unit area of exposed wall or roof surface of every cooled or conditioned building there is a continuous receipt of varying amounts of radiant energy and a continuous dispatch of other varying amounts. During the portion of each day during which the receipts exceed the dispatch, the ultimate disposal of the excess becomes of paramount importance. This is particularly true of insolated buildings under the direct rays of the sun when the "solar effect" becomes the major factor in the cooling load.

Finding no suitable formulas or tables as yet published for the rapid calculation of solar effect, I have endeavored to develop my own. The formulas offered herein have been developed rigorously and have demonstrated in practice a very satisfactory accuracy. By publishing my results, I hope to draw forth the suggestions of other students of this problem.

Solar Intensities

The very first item in the solution of sun effect problems is that of solar intensities. The older texts on physics assumed an intensity normal to the ray at stratospheric heights of 3 calories per sq. cm. per min. at the time of closest approach to the sun (mid-winter in the northern hemisphere). Recent accurate measurements by meteorologists give much lower values. The following table gives some of the results in B.t.u. per square foot per hour and assumes an absorption of 7% and a diffusion of 20% by the atmosphere in accordance with the mean of values given by various meteorological investigators:

Authority	Location	At Upper Level	At Sea Level	
			Direct	Indirect
Old texts	General	340.0	183.8	61.3
A.S.H.V.E.	40° N.	?	324.2	?
Meterologists	General	220.0	163.7	40.9
A. McAdie	Sea level		166.4	44.4
American U.	Washington		167.8	
American U.	Washington		170.1	
?	Santa Fe, N.M. 2,133 ft. elev.		202.1	

The writer recommends the use of 220 B.t.u. per sq. ft. per hr. for *S*, the intensity normal to the ray at the stratosphere.

Derivation of the Net Solar Effect

It is easily demonstrable that the unit intensity of the sun's rays upon any surface is equal to the product of the unit intensity normal to the ray and the sine of the angle between the ray and the surface. This angle is different for various times of the day, latitude of the locality, zenith distance of the sun, angle of the surface to the vertical and its orientation. Our first problem is to determine the direction of the sun's rays at the point on the earth's surface at any hour of the day. In the formulas given hereinafter, this angle has been determined by the angle *a* between the ray and the radius through the point, and the angle *b* which is the direction of the projection of the ray upon the tangent plane measured clockwise from the north. To a very close approximation, these angles may be determined from the two formulas following:

$$-\cos a = \sin L \sin D + \cos L \cos D \cos e \quad \ldots\ldots (1)$$

$$\sin b = \cos D \sin e \div \sin a \quad \ldots\ldots (2)$$

In which

D is zenith distance of the sun from the equator in degrees.
L is latitude of the place in degrees.
e is the hour-angle, or 15 times the time in hours from noon.

EXPLANATION OF SYMBOLS

S = Sun's intensity normal to the ray at the stratosphere.
a = Angle between sun's ray and the radius through a point. Vertical angle of sun's ray and surface of earth.
b = Angle between the projection of the ray on tangent plane measured clockwise from the north. Horizontal angle of projection of sun's ray and the north line.
D = Zenith distance of sun from equator in degrees.
L = Latitude of place in degrees.
e = Hour angle or 15 times the time (standard) in hours from noon.
j = Angle between tangent plane and surface plane (a wall or roof for instance) on which rays strike.
g = Angle between line of intersection (of surface plane on which rays strike and tangent plane) and east line measured clockwise.
m = Angle between sun's ray and surface plane.
I = Intensity on surface of earth.
N = Ratio between the solar intensity on the earth surface and the solar intensity at the stratosphere. In other words N is the term by which the sun's intensity at the stratosphere (S) is multiplied to obtain the intensity at the surface of the earth. It allows for angularity, absorption, etc.
N' = Same factor for a horizontal surface, when $\phi = 0$.
R = The reflection factor of the wall.
f = The transmission factor through the wall from air to air.
m = A factor defined as the transmission from outer surface to the air in the room.
A = The dry bulb temperature of the outer air.
T = The dry bulb temperature of the room.
K = The temperature of the outer surface of the construction.
c = The convection factor from a solid to air.
Hr = Heat received as radiation and absorbed.
Hc = Heat convected to outer air.
Ht = Heat conducted to room.
Tangent Plane = Plane determined by horizon.

†Exposure to the rays of the sun.
‡Consulting Engineer, Los Angeles, Calif.

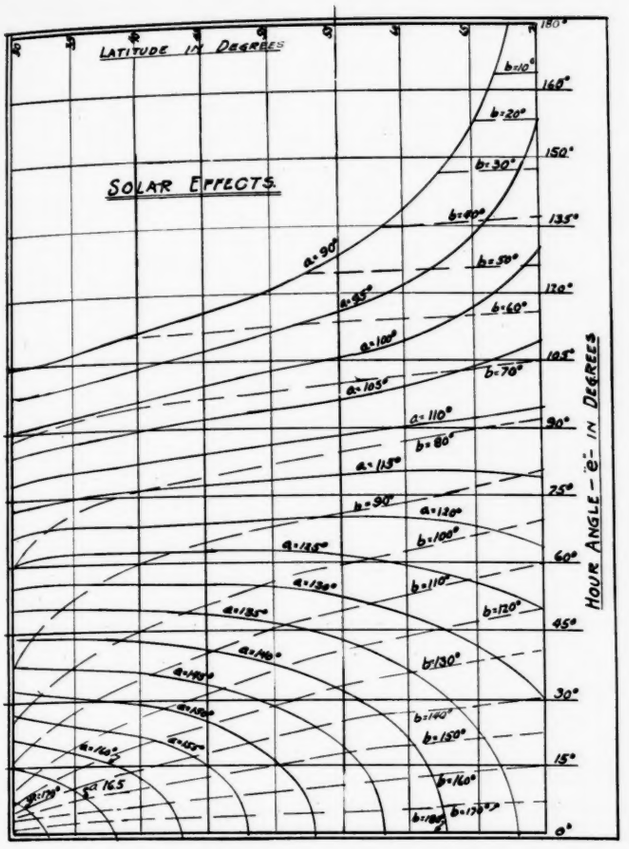

Fig. 1. For latitudes 30° to 70° north and all hour angles from sunrise to sunset when the Zenith distance of the sun from the equator is 23° north.

The second problem is to determine the angle between the ray and any surface through the point which makes an angle j with the tangent plane and whose intersection with the tangent makes an angle g measured clockwise from the east. The trigonometric solution gives the angle m between the ray and the surface.

$$\sin m = \cos a \cos j + \sin a \sin j \cos(b-g) \quad \ldots\ldots (3)$$

It is obvious that when a is less than 90° or more than 270°, the sun is below the tangent plane (or horizon): also that when m is less than zero or greater than 180°, the surface is in shadow.

Fig. 1 is plotted from formulas 1 and 2 for latitudes from 30° to 70° north and all hour angles from sunrise to sunset; when D is 23° north. Since the value of D varies from nearly 23½° north to 23½° south in each year these charts are strictly true only for the first and third weeks of June. In Los Angeles, this period coincides with the peak load conditions.

Fig. 2 is plotted to give the multiple N at all values of a and b as derived from formulas 1 and 2 above Fig. 1; but includes an additional factor for absorption by the atmosphere, *(1–.25 sin a)*.

Fig. 3 has been derived from Figs. 1 and 2 for Los Angeles, and has been very useful and convenient. The radial lines are to be considered normals to walls, the radial distances from the origin are values of N as in Fig. 2, and the hours are by solar time.

The sun's rays in passing from the stratosphere to sea level are subject to absorption by the atmosphere. Since the depth of this layer varies as sin a, and the total absorption per day is 7%, we may assume an approximate value of the hourly absorption as

$$S \times 0.25 \sin a$$

The reflective power of clouds may, by concentration, cause an increase of not more than 3%, which is negligible. The obscuring effect of clouds cannot be considered in the usual problem since it is accidental relief only.

The indirect or diffused radiation previously mentioned, and the reflection from the ground and surrounding buildings vary in the same sense as the intensity on a horizontal surface. The exact relationship is indeterminable except in specific cases. It is proposed here to make ample allowance for these by adding to the value of N (the factor for the surface under consideration), 25% of the value of N' for the horizontal surface. The correction is not applied to horizontal surfaces.

In resume, the intensity on a surface (I) is equal to:

$$(N + \tfrac{1}{4} N')S \quad \ldots\ldots (4)$$

Transmission of Radiant Heat Through Building Construction

Of the radiant heat reaching any surface (I in (4) above) a part is reflected and the remainder is converted into sensible heat of which a part is removed by convection to the outer air and a part is conducted to the interior of the room. A small part may be used up in raising the temperature of the wall but since more or less of this quantity will ultimately find its way into the room, it may be disregarded in the ordinary problem. Thus, the heat received and retained by the surface must equal the amount transmitted.

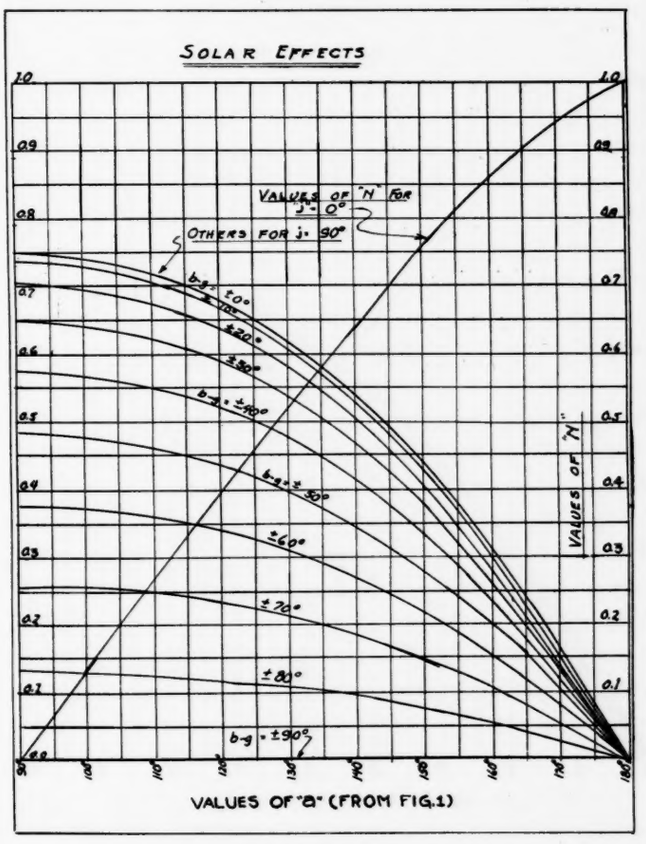

Fig. 2. For determining ratio (N) between the solar intensity on the earth's surface and the solar intensity in the stratosphere.

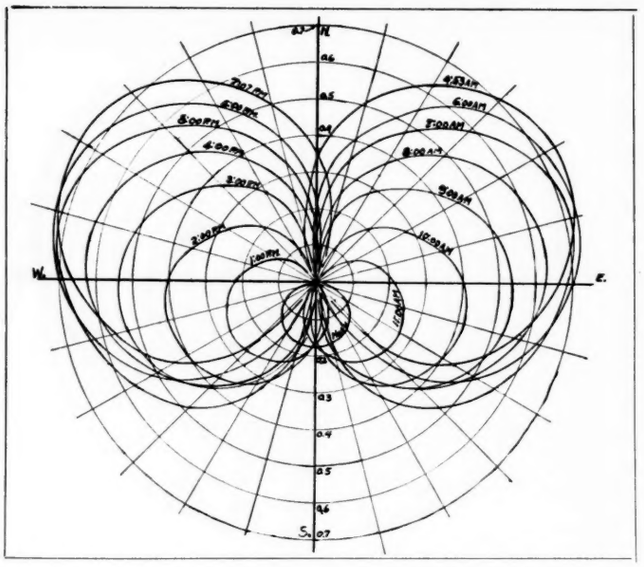

Fig. 3. The radial lines are to be considered normals to walls and the radial distances from the origin are values of N.

Let

- R be the reflection factor of the wall,
- f the transmission factor through the wall from air to air,
- m a factor defined as the transmission from outer surface to the air in the room,
- A the dry-bulb temperature of the outer air,
- T the dry-bulb temperature of the room,
- K the temperature of the outer surface of the construction,
- c the convection factor from a solid to air,
- Hr heat received as radiation and absorbed,
- Hc heat convected to outer air,
- Ht heat conducted to room,

Then

$$Hr = (1-R) \times I$$
$$Hc = c\,(K-A)$$
$$Ht = m\,(K-T)$$
$$Hr = Hc + Ht$$

Or

$$I(1-R) = c(K-A) + m\,(K-T)$$

From which

$$K = \frac{I(1-R) + cA - mT}{c + m}$$

$$Ht = \frac{m(I(1-R) + c(A-T))}{c + m} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

The usual derivation of f is from the formula

$$\frac{1}{f} = \frac{2}{c} + \frac{x'}{k'} + \frac{x''}{k''} + \quad \ldots\ldots$$

$$\frac{1}{m} = \frac{1}{f} - \frac{1}{c}$$

It is indifferent whether K is greater than A or less, but in air conditioning work it will generally be the former. Formula (5) eliminates K entirely and expresses the heat transmitted directly in terms of known or stipulated factors. From this formula, Fig. 4 has been prepared, the value of c being taken as 1.35. In the chart, values of $I(1-R)$ are plotted as abscissas to the right. A vertical from any previously determined value of $I(1-R)$ to the diagonal lines representing $(A-T)$ value; thence horizontally to the left to the proper value of f for the construction; thence vertically to the abscissas scale left to read directly the value of Ht in B.t.u. conducted to the room per square foot per hour.

The determination of the value of A or outside air temperature is largely a matter of observation of the variations common to the locality. Since the peak cooling load occurs during the period of light winds and slow mass movements of air, the local temperature follows the curve of maximum effective sun effect on horizontal surfaces very closely with a certain amount of lag, which depends on local geography and prevailing meteorologic trends. Fig. 3A is introduced at this point to illustrate the correlation as applied to Los Angeles and vicinity. The solid line is a corollary to Fig. 3 and shows the value of N' for a horizontal surface during the day. The dotted line superimposed is the variation of temperature on a typical day having a peak temperature reading. This temperature curve is not

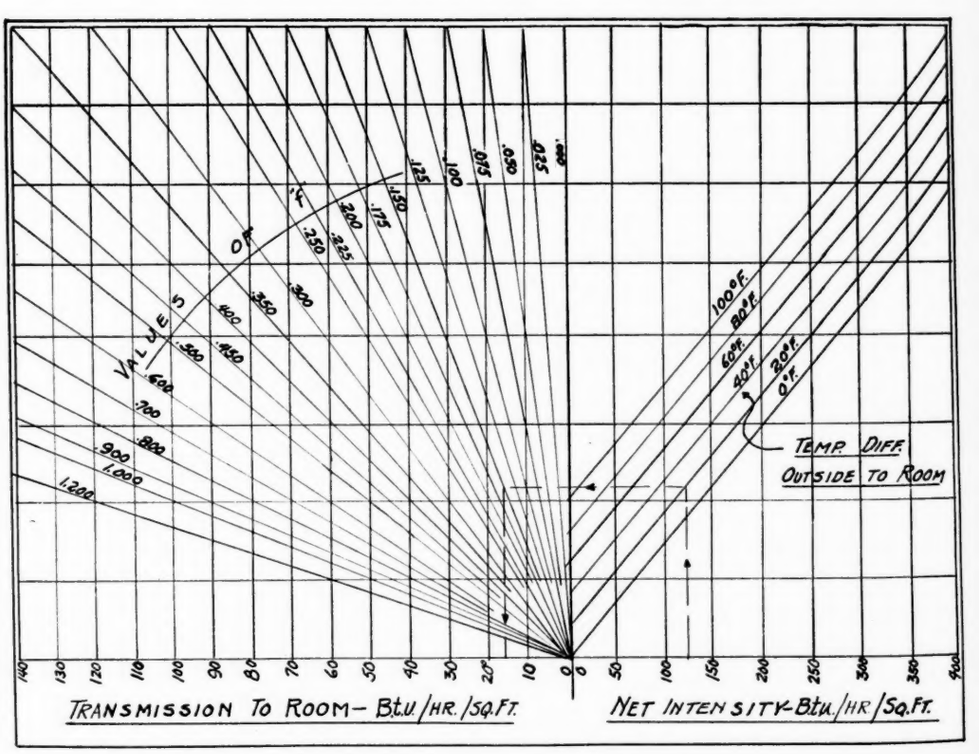

Fig. 4. Chart for determining the heat transmission to a room when the net solar intensity temperature differential and transmission factor are known.

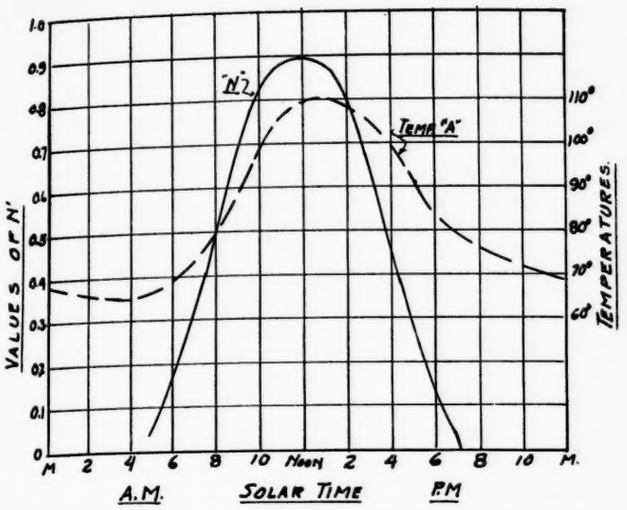

Fig. 3A.—Solar intensity on horizontal surface and hourly temperatures at Los Angeles, Calif.

applicable to all localities within 100 miles of Los Angeles because of the existence of local airways from the mountains to the sea, through which sea breezes lower the day-time temperatures and mountain breezes lower the night-time temperatures. The choice of values of *A* is very much a matter of individual judgment.

The writer has found these formulas and factors to result in smaller heat loads with an ample margin for safety. They provide means for rapid calculation of the loads for consecutive hours of the day, enabling the engineer to take full advantage of any heat-storing capacity available in the building. The writer has utilized this facility particularly in the storage of lemons. To cite one instance: A 40-ton refrigerating plant was made to suffice for the storage of 200 cars of lemons where the peak-hour load indicated not less than 65 tons. In this case, a rise in fruit temperature of ½F and in room temperature of 1F was permitted. Unless the heat load can be accurately foretold hour by hour, such savings cannot be achieved with safety.

Sound and Ventilation in Churches

MODERN engineering has accomplished two things which are a distinct aid in the comfort and appreciation of worship. It has made it possible to correct the acoustics in the auditoriums which have been difficult for speakers. Secondly, through the medium of air conditioning, it has made it possible to keep a sanctuary supplied with fresh air and at an even temperature regardless of the heat or cold without the walls.

It is hard to tell whether the first of these accomplishments is a greater boon to the congregation or the minister. There have been many historic church edifices where the preacher found it necessary to exhaust himself physically in order to get his voice to the entire congregation. Under modern conditions there is no reason why any speaker, with clear enunciation and an average volume, cannot reach the walls, and under the balconies, in any building.

Many times it is but a simple operation to equip a building for proper sound facilities. Echoes may be eliminated by ripping off the hard plaster and substituting any one of the several soft plastic materials which absorb rather than repel sound. The noisy street cars can be eliminated by proper insulation of walls and ceilings. There are some instances, particularly in sanctuaries of Gothic lines, where it will be necessary to install amplifying systems. But there is probably no auditorium in the world which cannot be made audible for the average voice if the task is given to engineers. This should be a great blessing to those ministers who are not equipped, by nature, with a strong bellows for thundering out their message and must be a double boon to the laymen who have had to sit in the front pews under such bellowing clergymen.

Good advice to laymen who insist that they can't hear the preacher is to put the matter up to the church trustees. Ask them what they are doing about equipping for proper sound transference.

Air conditioning is a similar and yet quite different problem. As yet, very few churches have any adequate system for this purpose. They must come to it. It is a little too much to assume that the man who rides in air conditioned railroad cars, eats in an air conditioned restaurant, attends an air conditioned motion picture house, sleeps in his air conditioned home, is going to worship in a sultry hot or a dead cold church. That is asking a little too much of human nature. It may explain some summer congregations. And, perhaps, some winter ones.

Air conditioning for churches offers its peculiar problems, more so than sound equipment. First of all, the sanctuary is in use but a few hours each week. That makes an investment in a full time system seem unnecessary. A second is that few churches have competent engineering help to maintain a complicated system of air conditioning. The fact that few churches have invested in any system has discouraged the firms which deal in these problems of giving much attention to church air conditioning. They tell you frankly that they have given little engineering energy to the matter.

Churches have been discouraged because of some of the earlier attempts in the field. Noisy force systems have been installed but their use discontinued. Some have installed fans which have reduced the temperature by several degrees and let it go at that. But, even admitting all of these difficulties, we do not see how any congregation can plan a new building or a reconstruction without considering the use of modern engineering to meet the problems of sound and ventilation.—*Church Management,* October, 1936.

EDITORIALS

Advising Homeowners

Last month we published an extensive extract from an article attacking this industry and some of its practices. The writer of that article—one of the few of its kind which have appeared of late—paraded just about all the possible indictments which might be drawn against the present practice of air conditioning in residences. As a result, he concluded that it would be wise for homeowners to put off purchasing air conditioning equipment for several years until there is further research and until the manufacturers have brought forth equipment better adapted to the needs of the owner. He implied that in that period it might very well come to pass that air conditioning will be shown not to be the boon to mankind that it is now represented to be.

It seems scarcely necessary to state that we do not agree either with the correctness of some of the alleged facts cited or with the broad conclusion drawn.

For one thing, we do not believe that air conditioning is now being sold to homeowners generally on the basis of any improvement in health which may be expected from it. There is some implication of this, but certainly the widest sales appeal is made on the basis of more comfortable living. We do not know of the slightest engineering or scientific evidence which shows that comfort cannot be decidedly increased by setting up good air conditions around a homeowner and his family. We do know of considerable evidence—evidence which to us seems conclusive—that comfort positively is promoted by a suitable method of conditioning the home air. In fact, we do not know that anyone disputes this general principle. We know of no one who would not prefer living in a suitably warmed house rather than remain exposed to the rigors of our natural climate.

Then, too, we doubt if it is true that air conditioning for homes is now being sold principally because of its summer appeal. Experience in the industry and all the available statistics point toward the conclusion that the winter appeal is the one most frequently used right now. Summer cooling is, we believe, represented by sellers generally and accepted generally by buyers as being an interesting and desirable feature in promoting comfortable living but not necessarily at all the controlling factor in making decisions regarding present purchases. Certainly, summer cooling is a factor, certainly it does bear more weight in some localities than in others, and to some homeowners it is probably the governing consideration. Not, however, in the majority of cases is this true now.

If, then, the present purchaser of air conditioning wants it for his comfort more than for his health and if he is more concerned with his comfort during the long winter period than during the summer, just what does he have to gain by deferring his purchase until a later date?

So far as we can see he stands to gain little or nothing. The winter air conditioning equipment now in use performs outstandingly well when put in properly. Prices are substantially stable. There is nothing of so revolutionary a character in the immediate offing that the homeowner who purchases now will see his winter equipment hopelessly obsoleted in any short period. In spite of all the mouthings to the contrary winter equipment is still built and operated on principles well proved. Innovations there have been, but no revolutions. Winter plants are now readily obtained which are amply protected against any development of summer cooling equipment which seems likely to materialize soon. It is difficult to conceive of any development of cooling which cannot be readily added to the winter plants now being installed.

But we have pointed out that there are some people to whom the summer appeal is the one of primary importance. What does such a one stand to gain by deferring his purchase for several years?

Strangely enough it seems to be little understood that the equipment used for accomplishing summer cooling in residences is not new. Merely because its application to this purpose is new many seem to feel that the equipment is itself new. Also there is a widespread feeling that the price will be greatly reduced one of these days due either to quantity production and sale or to some remarkable new invention which will come along.

So far as quantity production is concerned a considerable amount of this equipment is now produced by quantity methods, for quantity is achieved through using the equipment for purposes other than air cooling. Quantity selling is something which certainly cannot be achieved if everyone follows the advice to defer purchasing. A non-partisan and unheated view of the situation would lead to the conclusion that the homeowner stands only a slight chance of gaining anything worth mentioning from these sources.

So far as a remarkable new invention is concerned, there is no denying that the homeowner does stand a chance to gain here. In fact he stands just about the renowned "Chinaman's chance." The principles of air cooling are well established. An invention which would be so revolutionary as to substantially change the accepted principles would truly be breath-taking. It would take something of just about that character to really upset the value of the investment which a present purchaser makes.

No, it seems that from any angle the advice to defer purchasing merely to wait for developments is not sound. Not only is there nothing on which to base a prediction that methods will change greatly or that prices will fall sharply in any short period, but the owner loses to the extent that he gets along with reduced comfort to himself and his family while waiting for these mythical developments.

It does seem to us that there is sound and honest advice which can be given to prospective purchasers of air conditioning equipment for the home. It is the advice which we have used for a long time in our editorial correspondence.

We believe that nothing is to be gained by deferred purchasing but do believe that the purchaser should get competent advice before purchasing. He should deal only with people he knows locally or who bear a good local reputation for both knowing their business and for honest dealing. No one can do a gyp business long and not have his reputation catch up with him. Poor work speaks so loudly that it cannot be drowned out. A little ordinary sense and the exercise of prudence in dealing is really what the purchaser needs. Having that, he has little to fear; lacking it, he is a mark for anybody and no one can protect him against himself.

We believe that the great majority of purchasers are neither fools nor children and that by and large they purchase with their eyes open and in the possession of their sober senses. Let them by all means have all the facts they need. Let them be offered all the advice necessary, but let's be sure that the advice is well grounded.

ABSTRACTS of Current Papers, Books and Pamphlets

Heating, Ventilating and Air Conditioning

This book was written primarily to serve as a textbook for college students and presupposes a knowledge of thermodynamics. It differs from the usual textbook in that it utilizes sketches of actual commercial equipment in place of the usual conventional sketches to illustrate the theoretical application of thermodynamics developed by the texts. It differs from the previous books on heating and ventilating mainly in the extent in which thermodynamic principles and mathematical analyses are used to develop the ideas presented.

In gathering together the material the author has endeavored to make the book as complete as possible so that it can serve not only as a textbook for students but also as a handbook for the engineers and architects. Following is a list of some of the subjects presented: Properties and conditioning of air; loss and gain of heat through walls; radiators, valves and heat transmission from radiators; method of calculating heat required for rooms; direct steam heating; hot water heating; indirect steam heating-air flow-gravity systems; indirect steam heating-plenum systems-air conditioning; unit heaters; furnaces; boilers; heaters; automatic controls; District heating.

In the appendix of the book a large number of tables are presented. These tables include data on the properties of air and steam; infiltration through windows; wrought iron and steel pipe; conversion factors for cast iron radiators, and ratings and dimensions for various types of fans, boilers, unit heaters, and unit coolers.

[*"Heating, Ventilating and Air Conditioning," by Arthur M. Greene, Jr. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York. Cloth bound; 6 x 9 in.; 446 pages; price, $4.50.*]

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Study of Comfort Conditions

This is a report of an investigation made in English factories and offices under ordinary working conditions, and relates to the comfort of persons (mainly young women and girls) engaged in light work.

The report contains a study of the effects of the physical environment on the personal feeling of warmth; of the most comfortable conditions for persons doing light work; of the relative merits of different instrumental measures of warmth; and of the relation between the sensation of warmth and the temperature of the skin.

From a comparison of the correlations of comfort feelings with instrumental measurements it is concluded that equivalent temperature and readings of the globe thermometer are rather better indices of environmental warmth than any of the other instrumental readings considered. The globe thermometer is criticised on physical grounds, but in the calm air conditions which usually prevail in occupied rooms this instrument is evidently a useful index of warmth.

A distinction is drawn between feelings of warmth and impressions of the "freshness" of the atmosphere. For measuring freshness, which depends largely on air movement, the kata thermometer appears to be a suitable instrument; but as an index of warmth the kata thermometer appears to be inferior to the other combined measures which have been considered. Even the dry bulb temperature of the air was associated more closely than cooling power with comfort votes.

Maximum comfort was obtained with an equivalent temperature of 62.3F. This is the degree of warmth which will generally be found most suitable for workrooms and other places in England in which the occupants are engaged in sedentary or very light work. Under ordinary industrial conditions where there was no strong localized radiation and the temperature did not change very much between head level and floor level, and where the air velocity varied over only a comparatively narrow range, this condition was obtained with a globe thermometer reading of 65.1F, an effective temperature of 60.8F, a dry bulb temperature of 64.7F, and a dry kata cooling power of 6.1.

It was found that the mean surface temperature of the clothed body rises by about 0.7F for a rise of 1F in the temperature of the room. From the observations of body surface temperature, estimates have been made of the rate of heat loss by radiation and convection at different room temperatures. In "still" air the loss by radiation and convection varies from 21 B.t.u. per sq. ft. per hr. in an environment at 55F to 13 B.t.u. at 75F. At 65F this rate of heat loss is estimated at 17 B.t.u.

[*"The Warmth Factor in Comfort at Work," by T. Bedford. Published by His Majesty's Stationary Office, London. Paper bound; 6 x 9 in.; 110 pages; price, 2s. net. Obtainable in the United States at the British Library of Information, 270 Madison Ave., New York.*]

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Design and Construction of Ducts

This book treats the subject of duct design and construction in a practical manner and presents only enough of the theory of air flow as is necessary to make clear the principles of design and construction. It is to be particularly recommended to the non-technical man who desires to learn something of the installation of ductwork. Persons with a technical training but without experience in this field will find the large amount of practical data of considerable help to them. The author is to be congratulated on the excellent job he has done in gathering together practical information on duct design and installation and also on the excellent illustrations.

A list of chapter headings follows: Duct requirements for air conditioning systems; calculations for duct design and construction; inlet and exit duct openings; air recirculation; installation of ducts; materials and constructions; insulation and operation of ducts; air distribution; formulas; air ducts for transportation service for railroads and air friction chart.

[*"Air Conditioning—Design and Construction of Ducts." by Thomas J. Brett. Published by the American Technical Society, Drexel Ave. & 58th St., Chicago. Cloth bound; 5½ x 8½ in.; 226 pages; price, $2.50.*]

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Annual Air Conditioning Conference

This publication includes all of the papers presented at the first annual conference on air conditioning which was held at the University of Illinois, on May 4-5, 1936. The conference was a non-technical one for non-technical persons interested in air conditioning for human comfort. No attempt was made in any of the papers to discuss the many phases of industrial air conditioning. The following papers are presented in full: What is air conditioning?; comfort conditions and physiological factors in air conditioning; air conditioning and its effect on hay fever and pollen asthma; physical factors affecting comfort; air filters in air conditioning systems; air conditioning equipment; essential factors of heating systems; estimating the humidification requirements of residences; factors affecting fuel savings; calculations of the refrigerating load; research in summer cooling in the University of Illinois.

[*"Papers Presented at the First Annual Conference on Air Conditioning." Published by the Engineering Experiment Station, University of Illinois, Urbana, Ill. Heavy paper cover; 6 x 9 in.; 154 pages; price, 50c.*]

Retail Survey

Subscribers to the Dun & Bradstreet, Inc., service are receiving copies of the 1936 Retail Survey, published by that organization. One section is devoted to building materials, hardware and construction group, including analyses of the 1935 operations of 389 heating and plumbing contractors, 11 oil burner, stove and stoker companies, and 120 sheet metal shops. Data include the figures on typical net sales, cost of material sold, breakdown of operating expenses, merchandising ratios, and other information including profit and loss statements as broken down by size of concern.

[*"1936 Retail Survey, Building Materials, Hardware and Construction Group." Published by the Research and Statistical Div., Dun & Bradstreet, Inc., 290 Broadway, New York. Heavy paper cover; spiral bound; 5⅝ x 8½ in.; 58 pages.*]

The Domestic Coal Market

The Committee of Ten—Coal and Heating Industries, has distributed copies of an address on the domestic coal market and what to do about it, by W. B. Hughes, which was presented at the annual convention of the American Bituminous Retail Coal Merchants Association in Chicago, September 23, 1936.

The speech includes a very good summary of the market for coal and heating for buildings with particular reference to domestic stokers. Also includes pertinent market data.

[*"Domestic Coal Market and What To Do About It," by W. B. Hughes, American Radiator Co., mimeographed by the Committee of Ten—Coal and Heating Industries, 307 N. Michigan Ave., Chicago. Ten mimeographed sheets available on request to the Committee of Ten.*]

Number of Gas Heating Plants

A recent statistical bulletin of the American Gas Association gives comparative data on the number of gas-fired central heating installations in the United States as of July 1, 1935, compared with July 1, 1934. The figures, covering reports from 169 manufactured gas companies and 87 natural gas companies, are broken down to show the number of installations of gas-designed boilers, boilers with conversion burners, gas-designed furnaces, and conversion burners in furnaces for each of the utilities replying to the questionnaire. The figures are arranged by states with subtotals for the different states.

The compilation is valuable in that it is the only source of figures on the number of gas heating jobs but it has two shortcomings. First, the publication of the data was delayed so long that the figures are already obsolete by over a year, and second, reports are not available from all utilities having gas-fired building heating jobs on their lines. The survey is the eighth annual one of its kind and is devoted entirely to central heating installations and does not attempt to include homes or other buildings heated by circulators, gas radiators, or other gas space heaters.

The report shows that from 1934 to 1935 there was an increase of 12.8% in gas-fired boiler installations added to the lines of manufactured gas companies and 12.5% in those on natural gas company lines. The increase in the total number of gas furnace installations was 24.3% for the manufactured gas utilities and 11.5% for natural gas companies. The combined increases were 16.6% for the manufactured gas utilities and 11.8% for the natural gas companies.

The largest increase was in the number of conversion jobs in manufactured-gas-burning warm-air furnaces which showed an increase of 42.3%, followed by a 36.8% gain in converted boilers burning manufactured gas.

[*"Comparative Data on Gas-Fired Central Heating Installations, 1935-1934." Technical bulletin No. 19, published by the American Gas Association, 420 Lexington Ave., New York, July, 1936. Prepared by Paul Ryan, chief statistician. Includes the equivalent of 36 pages, 6½ x 10 in.*]

BRIEF REVIEWS

ROUND HEATING BOILERS. This paper is a report of a study made on round heating boilers to determine the relative amount of heat which is absorbed by the various sections. See page 51, July, 1936 issue HEATING & VENTILATING, for a review of this paper. [*"Relative Absorption of the Various Sections of Round Heating Boilers," by A. J. Johnson and P. A. Mulcey. Paper presented before semi-annual meeting of ASHVE.*]

GOVERNMENT PURCHASING. Specific information on government purchasing procedure for manufacturers, distributors, and associations. Includes a list of the important government purchasing and specifying offices. [*Prepared by National Division of the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C. Paper cover; 8½ x 11 in.; price, 5c.*]

STORE MODERNIZATION MARKET. An analysis of the physical condition and appearance of approximately 8,000 small and medium-sized stores and service establishments in 23 selected cities. The study reveals that over half are in need of modernization. [*"Store Modernization Needs—Market Research Series No. 8." Prepared by the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C. 8½ x 11 in.; 130 pages; price, 10c.*]

RESIDENTIAL MARKET. A study of the market for service hot water installations, electric and gas facilities in residences in 64 typical cities, based on the Real Property inventory survey. [*"Market For Electrical and Gas Facilities In Residences," Market Research Series No. 11, Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C. Paper cover; 8½ x 11 in.; 120 pages; price, 10c.*]

COAL FROM MINE WASTE. A report of an investigation undertaken to determine the nature of waste materials produced in the Illinois coal mines and the feasibility of recovering from them coal, pyrite, and other valuable constituents. [*"Possible Recovery of Coal From Waste at Illinois Mines," by C. M. Smith and D. R. Mitchell. Published by the Engineering Experiment Station, University of Illinois, Urbana, Ill. Bulletin No. 285. Heavy paper binding; 6 x 9 in.; 44 pages; price, 50c.*]

COAL UTILIZATION. This bulletin contains reprints of all the papers presented at the second annual short course in coal utilization held at the University of Illinois from June 11-13, 1935. [*Papers presented in the Second Annual Short Course in Coal Utilization, published by the Engineering Experiment Station, University of Illinois, Urbana, Ill. Paper cover; 6 x 9 in.; 163 pages; price, $1.*]

AIR MASS ANALYSIS. An introduction to the study of a method known as air mass analysis used by meterologists to forecast weather. Discusses the fundamentals of the method and includes a bibliography of the various publications on this subject. [*"An Introduction to the Study of Air Mass Analysis," by Jerome Namias and others. Third edition. Published by the American Meterological Societies, Milton, Mass. Paper cover; 6 x 9 in.; 84 pages; price, 60c.*]

FLOW OF FLUIDS. Presenting a method of analyzing the distribution of the flow of fluids in networks of pipes, ducts, and channels. The methods of analyses presented are methods of successful correction. [*"Analysis of Flow in Networks of Conduits or Conductors," by Hardy Cross. Published by Engineering Experiment Station, University of Illinois, Urbana, Ill. Heavy paper cover; 6 x 9 in.; 32 pages; price, 35c.*]

(Continued on page 80)

PSYCHROMETRIC TABLE

DRY BULB TEMP., F	SATURATED WATER VAPOR (Steam)				DRY AIR (at 29.92 Inches of Mercury)				AIR SATURATED WITH WATER VAPOR (Mixture at Pressure of 29.92 Inches of Mercury)						Wet Bulb Temp., F
	Pressure	Weight		Heat	Weight	Volume		Heat	Volume	Weight		Heat			
	Inches of Mercury	Grains, per cu. ft. of Vapor	Grains, per lb. of Dry Air at 29.92" Hg.	Total Heat, B.t.u. per lb. of Vapor	Pounds, per cu. ft.	Cu. ft., per Pound	Per cent, of Volume at 70 F	B.t.u. per lb. (from 0 F)	cu. ft., in 1 lb. of dry air with vapor to saturate it	Grains, of dry air in 1 cu. ft. of saturated mixture	Grains, in 1 cu. ft. of saturated mixture	B.t.u., in 1 lb. of dry air and enough water vapor to saturate it: To raise temp. 1 F	B.t.u., in 1 lb. of dry air and enough water vapor to saturate it: Latent Heat	B.t.u., in 1 lb. of dry air and enough water vapor to saturate it: Total Heat	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
— 20	0.0126	0.166	1.837	1050	0.08945	11.08	0.837	— 4.8	11.08	631.7	631.92	0.278	0.26	— 4.62	— 20
— 15	0.0168	0.217	2.437	1052	0.08842	11.20	0.849	— 3.6	11.208	624.5	624.69	0.264	0.35	— 3.23	— 15
— 10	0.0220	0.284	3.222	1055	0.08741	11.33	0.859	— 2.4	11.34	617.3	617.54	0.270	0.48	— 1.91	— 10
— 5	0.0290	0.368	4.228	1057	0.08651	11.45	0.865	— 1.2	11.46	610.8	611.19	0.277	0.614	— 0.56	— 5
0	0.0377	0.474	5.49	1059	0.08636	11.58	0.868	0.0	11.59	604.0	604.47	0.291	0.805	0.824	0
5	0.0489	0.607	7.12	1062	0.08540	11.71	0.879	1.20	11.72	597.2	597.8	0.302	1.05	2.28	5
10	0.0630	0.775	9.19	1064	0.08446	11.84	0.887	2.40	11.86	590.2	591.0	0.322	1.37	3.79	10
15	0.0807	0.983	11.78	1066	0.08354	11.97	0.896	3.60	11.98	584.3	585.3	0.340	1.80	5.4	15
20	0.1028	1.24	14.98	1068	0.08271	12.09	0.905	4.80	12.12	577.6	578.8	0.364	2.26	7.09	20
25	0.1304	1.55	19.01	1070	0.08183	12.22	0.916	6.00	12.24	571.9	573.5	0.396	2.87	8.91	25
30	0.1645	1.940	24.07	1073	0.08097	12.35	0.925	7.20	12.41	564.1	566.0	0.41	3.696	10.89	30
32	0.1802	2.12	26.39	1074	0.08065	12.40	0.930	7.68	12.46	561.8	563.9	0.43	4.05	11.72	32
35	0.2036	2.38	29.80	1075	0.08019	12.47	0.934	8.40	12.54	558.2	560.6	0.44	4.43	13.00	35
40	0.2478	2.87	36.40	1077	0.07937	12.60	0.944	9.60	12.70	551	553.8	0.47	5.56	15.21	40
45	0.3003	3.44	44.10	1079	0.07862	12.72	0.954	10.80	12.82	547	550.4	0.544	6.71	17.37	45
50	0.3624	4.11	53.50	1082	0.07782	12.85	0.963	12.00	13.01	538	542.1	0.574	8.13	20.29	50
55	0.4358	4.89	64.30	1084	0.07710	12.97	0.972	13.20	13.16	533	537.9	0.63	9.76	23.16	55
60	0.5214	5.77	76.95	1086	0.07634	13.10	0.981	14.40	13.34	525	530.8	0.70	11.63	26.31	60
62	0.5600	6.20	83.00	1087	0.07605	13.15	0.985	14.88	13.40	524	530.2	0.756	12.48	27.72	62
64	0.6004	6.63	89.10	1088	0.07576	13.20	0.989	15.36	13.48	520	526.5	0.75	13.44	29.25	64
65	0.6213	6.85	92.50	1089	0.07559	13.23	0.992	15.60	13.51	519	525.8	0.70	13.94	30.0	65
66	0.6433	7.05	95.46	1089	0.07547	13.25	0.993	15.84	13.54	517	524.0	0.80	14.55	30.7	66
67	0.6664	7.31	99.20	1090	0.07530	13.28	0.994	16.08	13.58	516	523.3	0.82	14.97	31.5	67
68	0.6898	7.57	102.50	1090	0.07519	13.30	0.997	16.32	13.60	515	522.6	0.84	15.44	32.32	68
69	0.7140	7.80	106.5	1090	0.07502	13.33	0.998	16.56	13.65	514	521.8	0.84	16.03	33.16	69
70	0.7387	8.06	110.2	1091	0.07491	13.35	1.000	16.80	13.69	512	520.0	0.86	16.60	34.00	70
71	0.7643	8.33	114.1	1091	0.07474	13.38	1.002	17.04	13.72	511	519.3	0.87	17.14	34.86	71
72	0.7906	8.59	118.1	1092	0.07463	13.40	1.003	17.28	13.77	509	517.6	0.92	17.74	35.71	72
73	0.8177	8.88	122.5	1092	0.07446	13.43	1.006	17.52	13.80	508	516.9	0.91	18.43	36.63	73
74	0.8450	9.16	126.8	1092	0.07435	13.45	1.008	17.76	13.84	506	515.2	0.92	19.00	37.54	74
75	0.8745	9.46	130.5	1093	0.07418	13.48	1.010	18.00	13.88	505	514.5	0.93	19.57	38.46	75
76	0.9040	9.76	135.4	1093	0.07402	13.51	1.012	18.24	13.91	504	513.8	0.94	20.30	39.39	76
78	0.9660	10.39	145.1	1094	0.07375	13.56	1.015	18.72	13.98	502	512.4	1.12	21.73	41.33	78
80	1.0320	11.05	156.0	1095	0.07348	13.61	1.020	19.20	14.07	499	510.0	1.12	23.31	43.58	80
85	1.2135	12.88	183.5	1098	0.07283	13.73	1.028	20.40	14.30	490	502.9	1.30	27.56	49.20	85
90	1.4210	14.95	217.2	1100	0.07215	13.86	1.038	21.60	14.55	482	496.9	1.50	32.36	55.70	90
95	1.6600	17.30	255.8	1102	0.07153	13.98	1.047	22.80	14.81	474	491.3	1.66	37.96	63.20	95
100	1.9320	19.96	300.5	1104	0.07087	14.11	1.059	24.00	15.06	465	485.0	1.86	44.00	71.50	100
105	2.2414	22.97	352.0	1106	0.07022	14.24	1.066	25.20	15.39	455	478.0	2.24	52.0	80.8	105
110	2.5940	26.37	413.0	1109	0.06964	14.36	1.074	26.40	15.71	446	472.4	2.44	60.9	92.0	110
115	2.9930	30.17	483.0	1111	0.06901	14.49	1.084	27.60	16.20	433	463.2	2.88	70.9	104.4	115
120	3.4450	34.40	566.0	1113	0.06845	14.61	1.095	28.80	16.50	426	460.4	3.24	83.0	118.8	120
125	3.9520	39.15	662.0	1115	0.06784	14.74	1.102	30.00	16.98	413	452.1	3.94	96.9	135.5	125
130	4.5220	44.30	775.0	1118	0.06729	14.86	1.113	31.20	17.50	401	445.8	4.6	113.0	155.2	130
135	5.1630	50.31	910.0	1120	0.06671	14.99	1.122	32.40	18.13	386	436.3	5.88	132.7	178.2	135
140	5.8780	56.85	1063.0	1122	0.06614	15.12	1.132	33.60	18.81	373	429.8	6.14	158.9	205.1	140
145	6.6780	64.10	1249.0	1125	0.06562	15.24	1.141	34.80	19.74	356	420.1	7.64	184.6	235.8	145
150	7.5660	72.00	1478.0	1127	0.06506	15.37	1.150	36.00	20.58	341	413.0	8.70	213.0	274.0	150
155	8.5530	80.80	1741.0	1129	0.06452	15.50	1.161	37.20	21.70	324	404.8	11.28	250.2	317.5	155
160	9.6490	90.50	2070	1131	0.06402	15.62	1.170	38.40	23.02	304	394.5	13.54	296.6	373.9	160
165	10.860	100.4	2480	1134	0.06349	15.75	1.180	39.60	24.70	284	384.4	16.70	354.6	441.6	165
170	12.200	108.4	2990	1136	0.06301	15.87	1.188	40.80	26.73	262	370.4	25.81	426.0	525.1	170
180	15.290	134.0	4540	1140	0.06200	16.13	1.209	43.20	33.95	207	341.0	50.24	643.4	783.2	180
190	19.00	169.0	7580	1145	0.06105	16.38	1.225	45.60	44.70	157	326.0	135.7	1068.9	1285.6	190
200	23.46	209.0	15,820	1149	0.06013	16.63	1.245	48.00	75.60	92.6	301.6	—	2217.1	2643.0	200

Vapor Pressures based on International Critical Tables. Total Heats based on Keenan Steam Tables.

Specific Heat of air at constant pressure — 0.24 B.t.u.; 1 lb. avoirdupois — 7000 grains.

Column 14 does not include heat of liquid; Column 15 does include heat of liquid.

Published by HEATING & VENTILATING, 148 Lafayette St., New York

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PSYCHROMETRIC TABLE

The psychrometric table which appears on the other side of this sheet is really a combination of three separate tables.

The one at the left gives the properties of saturated steam at low pressure. From the data given all the usual properties of low pressure steam may be read or derived.

The middle table gives the properties of dry air at atmospheric pressure and considered as a perfect gas. From this table any of the properties of dry air can be read or derived.

The table at the right gives important properties of a mixture of dry air and saturated steam. Such a mixture is commonly called "saturated air." It could equally well be called "air at 100% relative humidity." As a matter of fact it is the only air and steam mixture which contains saturated steam, for such mixtures at any relative humidity except 100% contain only superheated steam and no saturated steam. Also such a mixture of dry air and saturated steam contains the greatest weight of moisture which can be mixed with a given weight of dry air at any particular temperature.

Note also that columns 1 and 16 are the same. This is true because by definition the wet and dry bulb temperatures coincide when a steam and air mixture is "saturated" or when saturated air is under consideration. From this it follows that at any relative humidity except 100% the bulb is always less than the dry bulb reading.

Particular attention is directed to columns 14 and 15. These give the amount of latent heat and total heat, respectively, in a mixture of steam and air when saturated. Note carefully that the heat in column 15 includes that in column 14. These two columns give the amount of heat at the wet bulb temperature of column 16.

When this table is properly used it can replace any psychrometric chart of the same range, and any problem which can be solved by a chart can also be solved by the use of this table.

This table will be found especially useful for finding the amount of heat involved in humidity calculations.

The procedure in solving this type of problem is first to determine from known conditions the wet bulb temperature at the initial condition, then to find the wet bulb temperature at the final condition. With the two wet bulb temperatures known the heat quantities are read from the table. Subtracting gives the heat quantity per unit weight of air. This procedure can be simply expressed by the following equation in such a form that it applies directly to the table.

$$H_h = W\,(h_1 - h_2) \qquad (1)$$

H_h = Quantity of heat involved in a change of humidity between an initial wet bulb (t_1) and a final wet bulb (t_2), in B.t.u. per hr.

h_1 = Total Heat (column 15 of the table) at the initial wet bulb temperature (column 16 of the table).

h_2 = Column 15 of the table at the final wet bulb temperature of column 16.

W = Lb. of dry air per hr.

EXAMPLE: What quantity of heat is involved when 200 lb. of dry air from outside at a dry bulb temperature of 95F and a relative humidity of 50% are brought into a building and cooled to 85F and 45% relative humidity?

In the table locate 95F in column 1 and move horizontally to column 9, where 22.80 is read as the B.t.u. in each pound of dry air. Then move to column 14 opposite 95F and note that if the outside air were saturated at 95F it would contain 37.96 B.t.u. of latent heat. As it is only 50% saturated, multiply 37.96 by 0.50 and get 18.98 as the B.t.u. in the latent form at 50% relative humidity. The total heat per pound of outside air in the mixture is 22.80 + 18.98 or 41.78 B.t.u. This is h_1 in equation (1). In column 15 note that at 78F wet bulb the total heat is 41.33, while at 80F it is 43.58. Therefore, the wet bulb temperature of the outside air is slightly greater than 78F and less than 80F. Interpolation shows that the outside wet bulb is 78.4F.

Proceed exactly the same way in the table for the inside air. Opposite 85F in column 1, read 20.40 in column 9, then in column 14 read 27.56. Multiply 27.56 × 0.45 and get 12.40. Then, 20.40 + 12.40 = 32.80 B.t.u. This is h_2 in equation (1). Similarly, looking in column 16 it will be found that the wet bulb temperature of the inside air must be between 68F and 69F. Interpolation locates it at 68.5F.

Substituting in equation (1) we get:

$$H_h = 200\ (41.78 - 32.80) = 200\ (8.98)$$
$$= 1796 \text{ B.t.u. per hr.}$$

Sometimes, too, especially where humidity is decreased, it is desirable to be able to determine how much of the heat quantity involved is in the form of latent heat and how much is sensible heat. This can also be determined from the table. Column 14 can be used to advantage in this connection. In the example just given the latent heat in the outside air was 18.98 and that in the inside air was 12.40. The difference is, therefore, 1,796 — 1,316, or 480 B.t.u. per hr.

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WHAT READERS SAY • • •

Design Temperatures

I have been looking over Table 4, page 47, of the July, 1936 issue of HEATING & VENTILATING. I think some such table is very much needed at present, especially in view of the plan of the Installation Codes Committee to write a new code for Mechanical Warm Air Furnace Heating Systems. You know, of course, that they are using a table based on page 148 of the 1936 A.S.H.V.E. Guide. My objection to their table is that it is incomplete and my criticism of that published in the July HEATING & VENTILATING magazine is that when I came to compare certain items as for example in New York State. Lake Placid, N. Y., with Little Falls, N. Y., both with −20°.

Now, Lake Placid lies in a much lower average temperature than Little Falls, for it is high in the Adirondack Mts. and Little Falls is in the Mohawk Valley. Buffalo, N. Y., is given as −10°, while Ogdensburg is given as −20°.

If you are familiar with these two cities you probably would agree with me that Buffalo is one of the coldest places on the New York map and Ogdensburg isn't as cold as Lake Placid.

Or, taking another state with which I am fairly familiar. I cannot see any reason for giving Fall River, Mass., a −10° while New Bedford, closely adjacent, is rated 0°; why Concord, Mass., should be given −15° while Boston, less than 40 miles away and in much the same plane, is given as 0° and Pittsfield, which is high and cold, is given as −10°.

Any Yankee will tell you that Pittsfield is colder than Springfield.

Just one more: Rutland, Vt., is given as −20° while Burlington is given as −10°.

If familiarity with both is any guide, Burlington is the colder of the two.

I really think that this could be elaborated in many other cases, but these are simply some that we have checked ourselves.

My suggestion would be that these tables should be carefully revised and also that in the case of the Installation Codes Committee theirs too should be increased to give the cold states a larger number of places with which to make comparison. As for example, there are only five given in New York State while we have at least 47 varieties of temperature within a comparatively narrow range.

Boston is the only city given in Massachusetts for comparison and New Haven the only one in Connecticut, which is hardly fair for the state, especially as New Haven is of comparatively mild temperature and a city like Hartford would be much colder.

Perhaps it isn't possible to check any wider compilation but really it seems as if it was quite important that this should be done.

C. M. LYMAN,
Utica, N. Y. International Heater Co.

The points raised by Mr. Lyman are interesting and important. In connection with the method of arriving at design temperatures, HEATING & VENTILATING on July 23, wrote the following letter to D. E. French, Carrier Corporation, chairman of the ACMA committee on application standards:

"You will recall that in our July issue we printed the whole of your committee's Application Engineering Standards for Air Conditioning. In connection with these Standards we were particularly interested in your table showing the design temperatures for heating systems for a large number of cities and in the paragraph E relating to this table. In paragraph E we note that the Standards say the design temperature shall be 'that minimum temperature which has been recorded on more than 2% of the days when heating is required.' We would like to inquire as to the procedure followed in working out this table. In order to determine the design temperature according to paragraph E it would be necessary to examine daily Weather Bureau records, and if this was the case how many and what years were examined in arriving at an average figure.

"The reason we ask is that we are engaged in working on a table somewhat similar to this and we would like to know exactly how far your committee went in tabulating Weather Bureau data to arrive at these design temperatures. Any information which you can give us will be very much appreciated."

At the time of going to press no reply has been received. —Editor

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Vibration

Your very interesting article regarding the Namm's Department Store as being heated and cooled by Diesels was of great interest to us; but we wish to take this opportunity of calling your attention to what we consider a very important item, elimination of vibrations.

We feel that we can justly say that unless the Worthington Pump & Machinery Corporation had assured the Namm's Department Store (and frankly we do not know whether or not they were compelled to make a guarantee) that vibrations would not be transmitted through the building we doubt whether this installation would ever have been made, so important is the elimination of the transmission of vibrations in connection with the installation of machinery of all kinds and in all buildings, particularly such as the installation described by you. . . .

The Worthington Pump & Machinery Corporation, together with Messrs. Madeheim and Rosenthal, as well as our own engineers, made a very careful study of the proposed installation and finally a special method of vibration isolation was adopted and used to the perfect satisfaction of all concerned. . . .

THE KORFUND CO., INC. D. SUNDLAND,
Long Island City, N. Y. Secretary

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Psychrometry

I do not seem to be able to find this information about a steam jet system. This steam jet has a vacuum of 29.637 in. in the cold tank with a temperature of 50F. The vacuum is maintained at 28 in. in the condenser.

I would like to know what space is occupied by 1 lb. of evaporated water if the space is saturated.

In short, what is the cubic feet per pound occupied by steam vapor in a saturated condition at 50F with a vacuum of 29.63 in.

Omaha, Neb. R. P.

The question you raised about the cubic feet per pound occupied by saturated steam vapor at 50F with a vacuum of 29.63 in. is not strictly determinable because you do not give the reading of the barometer. However, a method of procedure can be outlined which can be applied as soon as the reading of the barometer is known.

If you will refer to page 57 of the June, 1936 issue of HEATING & VENTILATING, you will note the psychrometric table. The left hand part of this table gives the properties of saturated water vapor which is naturally the same as saturated steam vapor. In using the table the first step to determine is the pressure in a saturated space. To do this, subtract the vacuum in inches of mercury from the barometer reading in inches of mercury. This gives you a figure in column 2 of the table. In your case let us assume that the barometer reads 30 in. of mercury; subtracting 29.63 from 30 gives 0.37. Look down in column 2 of the table until you come to the number nearest 0.37. You will note that in column 1 this figure occurs opposite 50F. Actually,

the figure given in column 3 is 0.3624 which differs only slightly from 0.37. From this we conclude that when the barometer reads 30 in. and the vacuum in the saturated space is 29.63 in. of mercury, the saturated temperature is slightly above 50F. The temperature of 50F, however, is probably sufficient for your purpose.

Now, in column 3 opposite 50F, there appears 4.11 grains per cubic foot of vapor. There are 7,000 grains in 1 lb. avoirdupois. Therefore, the 4.11 grains is equivalent to 4.11 divided by 7,000, or 0.000587 lb. per cu. ft. Pounds per cubic foot are the reciprocal of cubic feet per pound. We can change the 0.000587 lb. per cu. ft. into cubic feet per pound by dividing unity by 0.000587. On doing this, we get 1703.6 cu. ft. per lb.

We understand from your enclosed card that you would like to know the cubic feet per pound of saturated water vapor when there is a 28 in. vacuum in a space having a temperature of 45F. Looking at the psychrometric table above mentioned you will note that at a 45F temperature, the saturated pressure is given as 0.3003 in. of mercury. Now for a 28 in. vacuum referred to on a 30 in. barometer, the absolute pressure in this space is 2 in. of mercury. Again looking at the table, the temperature nearest corresponding to a pressure of 2 in. of mercury is slightly over 100F. It is obvious, therefore, that it is impossible for a space to be saturated when at a temperature of 45F and an absolute pressure of 2 in. of mercury. It can only be saturated at a temperature slightly over a 100F and, therefore, I do not see how most of the spaces on the card which you attach to your letter can be filled in.

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House Air Conditioning

In the September issue, HEATING & VENTILATING reprinted an article from "The New Republic" by D. H. Palmer in which Mr. Palmer asserted that conditioned air for residences is still far too high in cost and that there are still too many "bugs" in residential air conditioning to make it desirable for the homeowner to invest in air conditioning equipment. The letter below comments on Mr. Palmer's article.

The writer, who prides himself on being a disciple of the doughty Hank Menkin, is no foe of the modern game of de-bunker.

Mr. Palmer is no doubt afflicted with the same disease. A chronic de-bunker has so much material on which to work that I am surprised that he should seize on our poor struggling little industry, when the soap ads in the daily papers and the radio stomach gas eliminators are leading with their chins.

There is no question but what we can survive without air conditioning systems. We can survive without washing machines, vacuum cleaners, and oil burners. The central heating plant might vanish and civilization would still survive.

The Lowells and Cabots survived without them. The Lowells and Cabots also survived without bathtubs or indoor toilets, but B.O. was no disgrace in those days.

I have been informed that the bicycle and a sudden fostering of strenuous exercise for females laid the foundation for the bathtub industry.

Thirty years ago or more the great middle class made a ritual of the Saturday night bath. To bathe every day smacks of the old Roman, who according to a Victorian point of view and if history were to be relied upon was no better than he should be. Also it was inconceivable that a female should perspire, let alone sweat. All books on physiology and physicians to the contrary, but sweat she did and how, and the bathtub came into its own.

Now the sin of B.O. cries out to us from every magazine, and the street car ads. People suddenly realized that they were dirty and they did something about it.

We have begun to realize that most of our homes are too hot or too cold, too damp or too dry, and stuffy. The time is not distant when we will resent the criticism of the air condition in our homes just as we would now resent any criticism of the drink or food we serve, or of our hospitality.

Maybe air conditioning is a product of the jazz age as is the automobile and the crooner, but the only logical question is: "So What?"

Residential air conditioning isn't suffering from growing pains as it hasn't really been born yet, but I will wager the good Doctor Palmer a can of copenhagen that it will make faster progress than the automobile industry did and that people are going to buy it and bite and buy again, and they are going to like it.

Of course, we oversell it. Everything is oversold. We sell John Q. Public an air conditioning system and he doesn't believe all we say about it any more than his daughter believes that she will marry Edward the VIII or Clark Cable if she washes her undies in whoosis soap.

Air Conditioning may be a much-abused word but it's the only word we have, and it tells the story.

If you place a tea kettle of water on the stove and add moisture to the air that needs it, you are air conditioning it to that extent. A desk fan is a conditioner, probably not a system, but a conditioner nevertheless.

There are hundreds of manufacturers today who are making air conditioning apparatus, and I count on the fingers of one hand the firms or manufacturers who deliberately falsify or lie about their products. In 99% of the cases, the apparatus will do what they claim for it and the home is better and more livable for having it installed.

I am not going to bore the eminent Doctor Palmer with the progress yours truly has observed and help promote the air conditioning industry in the past thirty years. It's true we didn't call it air conditioning then, but what matters the name.

We of the industry have made mistakes. We are making mistakes and we will probably make mistakes in the future, but no known advance in any commodity for the comforts or convenience of the home was ever developed to the *n*th degree in a laboratory and then sold to the public guaranteed not to run, rip, or wear out at the heel. Progress just isn't made in that way.

Would Harris Palmer be riding in his deluxe today if the public would have accepted the same advice in 1908 and waited until 1936 to buy a car?

FURBLO CO., Hermansville, Mich. — PLATTE OVERTON, Chief Engineer

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Heat Loss Coefficients

We would like to know the value of "U" in the following constructions: brick veneer, wood sheathing, 4-in. studs, metal lath and plaster, with the following insulations: (1) 4-in. rockwool as delivered on the job; (2) one layer of aluminum foil insulation; (3) two layers of aluminum foil insulation with ¾-in. air space between each layer.

We say rockwool as delivered on the job because we have heard that the value of the material on the job is different from the value of the same material when specially kiln dried for test purposes.

New York, N. Y. — M. S.

For the plain brick veneer wall without any insulation the value of "U" is 0.23. With 4-in. rockwool in the above construction the value of 0.057. With one layer of aluminum foil insulation the value is 0.211, when the insulation is polished on one side only. When both sides are polished and the sheet is mounted so that there is an air space on each side, the value is 0.138. With two layers of aluminum foil insulation, with ¾-in. air space between each layer, each sheet bright on one side only, the value is 0.199; bright on both sides, the value is 0.103. The values of the heat conductance of the aluminum foil vary considerably, according to different tests. Values used for calculating the above coefficients, however, are believed to be substantially correct. The value of rockwool was calculated by the Bureau of Standards, which reports that since rockwool is not hygroscopic any special drying would have a negligible effect on its heating transmission so that drying would only be necessary in case the material has been in direct contact with liquid water.

NEWS OF THE MONTH

Stoker Campaign Under Way

BIRMINGHAM, ALA.—The Birmingham Electric Co., with six cooperating dealers is conducting an intensive coal stoker sales campaign, expected to double the stoker sales of last year. Dealers joining in the promotion are the Arnold Supply Co., Clark & Jones, James Arthur Smith Co., Birmingham Electric Battery Co., R. P. McDavid & Co., and George F. Wheelock Co. The campaign runs from September 15 to October 15.

Fifty-seven color billboards carrying the story of coal stokers were erected and a number of 20-in. advertisements bearing names of the dealers were published in the newspapers. The utility sent out literature to a mailing list of 7,000. The utility does not sell stokers itself, but turns names of prospects over to the dealers. Appropriate stickers were placed on all company mail, several hundred cards for automobile bumpers furnished, and the campaign promoted in other ways.

The utility employs a heating engineer who gives his services free to dealers in making surveys, closing deals, and training salesmen.

Coal stokers were chosen for the campaign because Birmingham is a coal producing center, but dealers in other types of automatic heat were able to tie in with the campaign without disadvantage.

A.C. Courses Continued

BOSTON—The Massachusetts Department of Education is continuing this school year the instruction in heating, ventilating and air conditioning that drew such a great response last year. De Witt M. Taylor, formerly of M.I.T., gives a course in practical combustion in eight lectures, and John E. York, formerly of Stone & Webster Engineering Corp., will give 16 lectures in two parts on heating and ventilating. Both these courses, conducted evenings, are also offered by correspondence.

P. A. L. Foulds, consulting engineer, is giving a course in air conditioning for residences, restaurants, stores and offices. Raymond U. Fittz, of Tufts College Engineering School, is giving another course in air conditioning for factories, theaters and other large buildings. This is especially prepared for operating men as well as designers and draftsmen, the former having had difficulty in obtaining information on approved methods for the necessary calculations. Mr. York also has a course in air conditioning calculations and design for men who are familiar with the fundamentals of heating, ventilation or air conditioning. The course by Professor Fittz is also offered by correspondence.

Public Health Ass'n to Meet

NEW ORLEANS, LA.—There will be a number of papers on the program of the 65th annual meeting of the American Public Health Association, to be held here Octobber 20-23, which will be of interest to heating and ventilating engineers.

Among the papers to be presented are: Review of Research Methods and Progress in Industrial Sanitation, by Theodore Hatch; Industrial Hygiene Study of Foundry Industry in New York State, by Dr. Leonard Greenburg; A Study of Air Pollution in New York City, by Sol Pincus; The Application of Engineering Surveys to the Hatters' Fur Cutting Industry, by J. J. Bloomfield and J. M. Dalla Valle; Program of the Foundry Industry for Dust Control. by E. O. Jones; Housing as a Public Health Problem, by Dr. C.-E. A. Winslow.

Full information regarding train rates and hotel rates can be obtained from the headquarters of The American Public Health Association, 50 W. 50th St., New York.

Bichowsky Speaks in St. Louis

ST. LOUIS — The regular monthly meeting of the St. Louis chapter of the ASHVE was held September 8 at Garavelli's. Dr. F. Russell Bichowsky, research director, air conditioning div., Surface Combustion Co., delivered an address on "Industrial Drying with Lithium Chloride in Its Relation to Air Conditioning."

Doctor Bichowsky pointed out that the deliquescent salt, lithium chloride, possessed definite uses as a water absorbent in air conditioning. An especial advantage of lithium chloride, according to Doctor Bichowsky, is the ease with which it may be reactivated.

Boston A.C. Meetings Start

BOSTON — Don J. Edwards, general manager, General Heat & Appliance Co., distributor for Delco Heat and Frigidaire air conditioning, was the principal guest speaker September 24, at the first fall meeting of the Air Conditioning Bureau of Boston. His subject was "Automatic Heat and Residential Air Conditioning." This was the first of a series of meetings which will be devoted to automatic heat and residential air conditioning, with speakers well known in engineering, banking, real estate, and architectural circles presenting their views on the subject. New developments in the field will be discussed by representatives of manufacturers and contractor-dealers. Residential builders, architects, real estate and apartment house owners will be guests at these meetings.

Engraving Plant Installs Cooling

MERIDEN, CONN.—A windowless second story addition, in which two rooms are completely air conditioned, has been constructed by the Meriden Gravure Co., 47 Billard St., a printing firm. Equipment consists of a G-E air conditioning unit and a condensing unit, installed by S. O. Olesen, 81 Randolph Ave., local distributor of G-E oil furnaces and air conditioning equipment. The conditioned rooms are used for special photographic processes in connection with photo-gelatine printing.

Anthracite Industries Announces Field Appointments

NEW YORK — Anthracite Industries, Inc., has appointed sales staff representatives for three territories—Brooklyn, New Jersey, and Rochester, N. Y. Daniel A. Zupa will be in charge of field work in Brooklyn; Charles A. Heslin will carry on these activities in northern New Jersey, while Norman Curtin will operate out of Rochester, N. Y.

Printing Plant Installs A.C.

ST. LOUIS — The Woodward and Tiernan Printing Co., 1519 Tower Grove, this city, which uses gas to heat its power boilers, has added a gas-operated air conditioning system in the office and lithograph press room. A silica gel dehumidification unit, compressor and cooling coils, and a gas heating unit will maintain a constant temperature of 80F and a relative humidity of 50% winter and summer.

Takes Over Supply House

ST. JOSEPH. MO.—Aitchison-Richmond Supply Co., 209-11 S. 4th St., this city, has taken over the business of the W. B. Howe Supply Co., also of this city. The firm will handle heating, plumbing, water works, gas and mill supplies.

Opens Offices

PHILADELPHIA—Leslie S. Tarleton has opened offices in the Architects Building here where he will practice consulting engineering. Mr. Tarleton was formerly district engineer for Peirce-Phelps, Inc., Chrysler distributor of this city.

Refrigeration Service Engineers to Meet in Memphis

CHICAGO—The Refrigeration Service Engineers Society, an organization composed of men servicing and installing domestic and small commercial refrigerating equipment, will hold its third annual convention at the Hotel Gayoso, Memphis, Tenn., November 11-13, 1936. An attendance of five hundred is expected.

The educational program planned for this meeting will occupy the afternoon sessions, which will be held from 1:30 to 5:30 p.m. The speakers will include prominent engineers on various subjects, who have been selected because of their prominence and experience. Among the subjects which will be covered will be "Use of Various Neutralizers for Refrigeration Gases When Purging, and the Use of Neutralizers in the System," "Unit or Forced Draft Coolers — Where to Use Them and Specific Examples of How to Figure," "Conversion of Flat Belt Drives to V-Belt Drives," "How to Figure Proper Compressor Capacities for Various Applications," and "How to Figure a Specified Air Conditioning Job."

In connection with the convention is a manufacturers' exhibit in which some forty leading manufacturers of refrigerating equipment, accessories and supplies will exhibit their products.

National headquarters of the society are located at 433 N. Waller Ave., Chicago. H. T. McDermott is the national secretary.

Furnace Men to Meet in Chicago

CHICAGO—An important event to the warm air heating and air conditioning industry will be the convention of the National Warm Air Heating and Air Conditioning Association, to be held in the Stevens Hotel, Chicago, December 15-17.

Managing Director A. W. Williams, Columbus, Ohio, reports that the committees having this meeting in charge have their plans well under way for a most valuable gathering. The first day as usual will be devoted to various meetings of the standing committees, and of the association's board of directors. The second and third days will be occupied by convention sessions.

A.C. for Country School

PORTLAND, ME.—An air conditioned rural school, with automatic heat, humidified and washed air, has just been completed at Sanford, Me., and is considered the model school of its kind in the country. The building is triple insulated and has movable furniture with specially designed posture seats.

Hard Coal Group to Exhibit

NEW YORK—A comprehensive display of anthracite burning equipment will be exhibited at the Eastern States Exposition September 20-26 at Springfield, Mass. Under the auspices of Anthracite Industries, Inc., some twenty-five or more manufacturers of equipment, including stokers, boilers, hot water heaters, and temperature controls, will exhibit their products.

Among the companies which will participate are Aga Stove, American Radiator Co., Burnham Boilers Co., Dickson & Eddy, Electric Furnace Man, Inc., Estate Stove Co., Fitzgibbon Boiler Co., Freed Heater & Mfg. Co., Hershey Foundry Co., Iron Fireman, Jeddo Stove, Kol Ax, Inc., New York French Range, Schwitzer Cummins Co., H. B. Smith Co., Spencer Heater Co., and Taco Heaters.

Gas Heat for Subway Station

BROOKLYN — Gas heat has been installed in the Myrtle Ave. station of the Canarsie line of the New York Rapid Transit Corporation, according to the Brooklyn Union Gas Co. This is the first railroad station in the city in which gas heat has been installed.

The installation will be a test to determine the desirability of gas heat for the transit corporation's stations. An analysis of eight stations by the railroad showed that gas permitted a saving of 20%.

Requests Catalogs

HAMPTON, VA.—Alfred Abboud, head of the plumbing and heating department of Hampton Institute, this city, is assembling a file of catalogs of firms manufacturing or selling heating, air conditioning, and similar equipment for use in connection with repairs to and replacements of the mechanical equipment in about 150 buildings. The file is also available to students enrolled in a four-year course in which these subjects are taught. Mr. Abboud requests that he be placed on the mailing list of manufacturers to receive engineering data and catalogs.

To Certify All Jobs

BOSTON—Effective September 1, the Heating, Piping & Air Conditioning Contractors Association of Boston began certifying all heating, piping, and air conditioning jobs done by members, where heretofore such certification was applied only to complete residential jobs. Under the program all contractors installing certified heating will engineer their work in accordance with recognized standards, and subject them to inspection and approval during and after completion of the work, in order to secure certification.

Chicago Code Hearings Begin

CHICAGO—Hearings on the city's proposed new building code began early in September by a city council subcommittee and they will continue until a complete review has been made, the chairman announced.

In answer to criticism of delay, the chairman pointed out that the subject of a new code was first brought up nine years ago while recommendations were not submitted to the city council until this spring. Since then the council sub-committee has been hearing representatives of various industries. Now with the hearings of the proposed code begun the committee hopes to give the city a modern building code which will withstand legal attacks.

Sears A.C. Retail Stores

ST. LOUIS—Early in July two Sears Roebuck and Co. retail stores here were equipped with steam jet air conditioning systems. The installations have a capacity of 180 tons, which permits the maintenance of a 15F differential between indoor and outdoor temperature in the warmest weather. Both Sears stores consist of three floors and cover half a city block.

Match Plant Installs Dehumidifier

ST. LOUIS — The air conditioning equipment recently installed in the factory of the Universal Match Co., Ferguson, Mo., near St. Louis, has been equipped with a lithium chloride dehumidifier. Only a small number of the lithium chloride water absorption systems are as yet in operation in industrial installations, the Universal Match Co. being the first plant in St. Louis so equipped.

Gar Wood Forms Canadian Subsidy

TORONTO, ONT.—The Gar Wood Industries, Inc., Detroit, is now incorporating a Canadian subsidiary and has leased a considerable area in No building of the Dominion Motors plant at Leaside for manufacturing purposes. The new firm will manufacture air conditioning and oil heating equipment.

A. C. Cars for Maine Central

WATERVILLE, ME. — Five air conditioned cars, using ice, are to be placed in service on through trains of Maine Central road shortly, at a cost of $14,000 each for equipment and modelling in the company's own shops here.

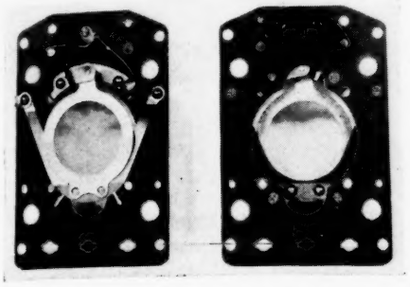
NEW EQUIPMENT

Leland Thermal Release Switch

NAME—Leland thermal release switch.

PURPOSE—To prevent burning out of motors when the starting current becomes too heavy or when the motor develops an over-heated condition.

FEATURES—Device is so designed that it must be set by hand. This is done so that



if the device trips frequently the trouble will be called to the attention of a serviceman. The manufacturer states that it should be noted that the device is not an overload protection but an overheat protection. It is the purpose of the switch to keep the motor on the line at any load possible for the motor regardless of its relation to the normal rating as long as no permanent damage is done to the parts by heat.

MADE BY—*The Leland Electric Co., Dayton, Ohio.*

Bacharach Draft Gage

NAME—Draftrite vestpocket draft gage.

PURPOSE—For measuring draft intensity ranging from 0.14 in. up-draft to 0.10 in. down-draft.

FEATURES—Designed for hand operation and manufacturer claims that readings can be obtained practically instantly. The instrument indicates draft intensity to 1/100 in. of water. Illustration is full size. Instrument weighs less than 3 oz.

METHOD OF OPERATION—One end of the draft tube is inserted in the hole at the top of the gage while the other end is placed in the flue pipe. A finger is then placed over a hole at the bottom of the gage and the gas is leveled so that the pointer reads zero. When the finger is removed, the pointer indicates the draft intensity.

MADE BY—*Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh.*

Hershey Motorstokor

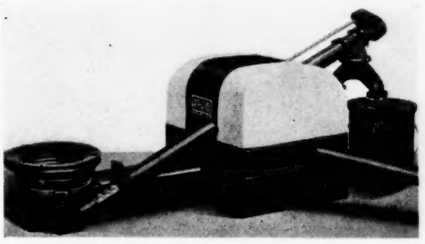
NAME AND MODEL NUMBER—Motorstokor, series 8AF.

PURPOSE—Stoker for automatically burning anthracite coal, feeding it from a bin and carrying the ashes to cans.

FEATURES—Standard make capacitor type motor with built in overload protection, pressure type self compensating fan, universal type coal bin conveyor which can operate at any angle. V-belt speed reduction with an automatic overload switch, coal feed screw of chrome-moly alloy steel. Burners consist of series of concentric rings designed to distribute air to fuel bed uniformly. Ash removal system of heavy cast iron paddles revolving on a ball race.

SIZES AND CAPACITIES—Three models, 20 to 40 lb. per hr.

MADE BY—*Motorstokor Div., Hershey Machine & Foundry Co., Manheim, Pa.*



Janitrol Gravity Heater

NAME—Janitrol gravity heater.

PURPOSE—For supplying warmed and humidified air.

FEATURES—The heater has no bonnet, utilizing instead a streamlined heat distributor in the enclosed head to assure equal heat to each riser. Model has a Multi-Inspirator burner and a humidifier of the pan type.

MADE BY—*Surface Combustion Corp., Toledo, Ohio.*

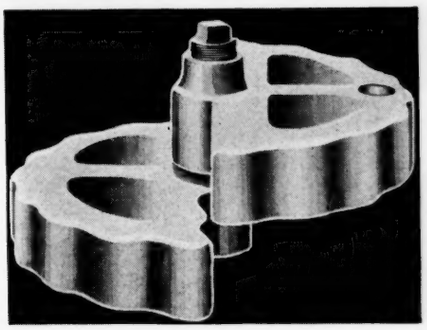
Sturgis Heat Booster

NAME—Sturgis Heat Booster.

PURPOSE—To increase the heat surface of boilers.

FEATURES—Constructed of two cast iron sections fitted together with a water-tight ground joint and held together by a bolt to prevent warping. By removing the cap nut and the nut on a larger inside bolt, the Booster may be taken apart so that it can be installed through the firebox door. The manufacturer claims that the design makes the booster an effective flame baffle. It is said that the unit can be installed without disturbing hot water coils already placed in the boiler.

MADE BY—*Whitehall Equipment Corp., 17 Battery Place, New York.*

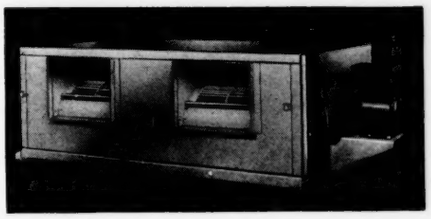


Trane Climate Changer

NAME—Trane Climate Changer.

PURPOSE—For supplying year 'round air conditioning for residences and small buildings.

FEATURES—Casing: water-tight bottom insulated with ½-in. insulation and provided with 1-in. drain connections for excess water.



Access panels on both sides for removal of filters and access to coils, humidifiers, bearings, etc. V-belt drive with adjustable pitch diameter pulleys. The motor is available in either constant speed or two-speed types. Cooling coils of light-weight heat transfer surface for either direct expansion refrigerants or water. Heating coils of fin tube construction with headers of cast iron. Self-cleaning spray nozzle humidifier; throw-away type filter.

SIZES AND CAPACITIES—12 sizes ranging from 33,000 to 360,000 B.t.u. per hr. heating capacity and 16,000 to 117,800 B.t.u. per hr. cooling capacity.

MADE BY—*The Trane Co., La Crosse, Wis.*

Independent Permo Pad Air Filter

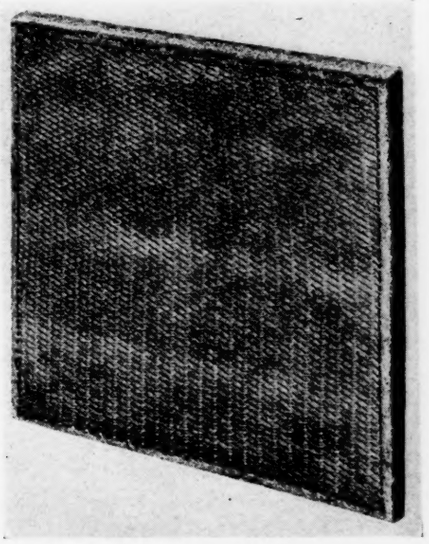
NAME—Permo Pad air filter.

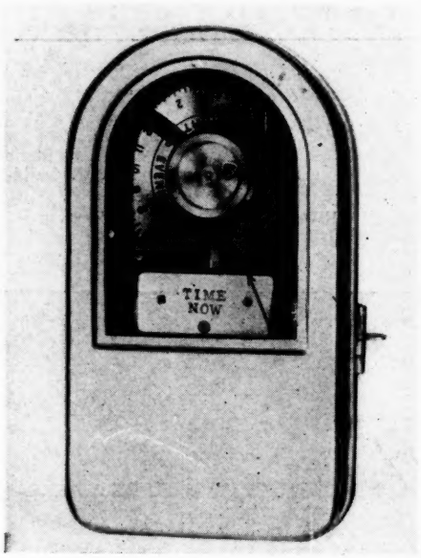
PURPOSE—Filtering air.

FEATURES—The manufacturer claims that the filter is a washable, moistureproof, and acidproof unit which is odorless, sterile, and has a large storage capacity. The filtering media is loosely packed on the entering air face and densely packed on the exit side so as to extend the usefulness. Manufacturer says that it can be readily cleaned either by beating or by washing in hot water, steam, or naphtha. The initial resistance of a single pad is 0.09 in. water gage.

SIZES AND CAPACITIES—Standard sizes ranging from 10 x 10 x 2 in. to 20 x 30 x 2 in. with capacities from 200 c.f.m. to 1,200 c.f.m.

MADE BY—*The Independent Air Filter Co., 215 W. Ohio St., Chicago.*





Little Giant Tork Clock

NAME—Little Giant Tork clock.

PURPOSE—Daily automatic control of electrical circuits.

FEATURES—Clock operates without winding or regulating and may be set on various schedules without use of tools. The device is made of non-corrosive materials including brass, stainless steel, and moulded bakelite. Fast moving gears run in a sealed oil chamber. The 24-hr. day is divided into four sections, of 6 hr. each, covering morning, afternoon, evening, and night. The device has 5,000 watts capacity for either single or double pole service.

MADE BY—*The Tork Clock Co., Inc., Mt. Vernon, N. Y.*

Taylor Binoc Tubing

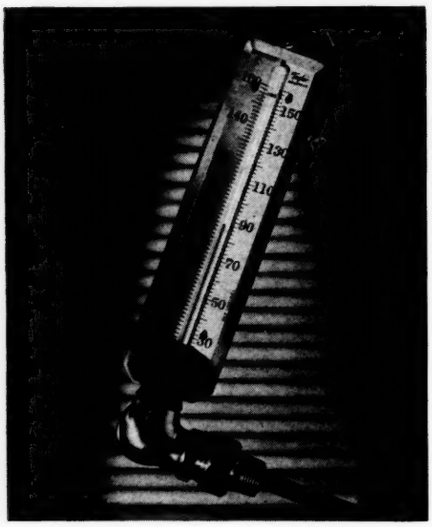
NAME—Taylor Binoc tubing.

PURPOSE—A new glass tubing for industrial thermometers to improve their readability.

FEATURES—More than twice the accustomed angle of vision combined with high magnification of the mercury column. Triple lens construction which is said to gather three times as much light as in the ordinary tubing and concentrates it behind the mercury column, making the column stand out in sharp relief.

AVAILABLE ON—All popular straight angle and handled forms of thermometers.

MADE BY—*Taylor Instrument Companies, Rochester, N. Y.*

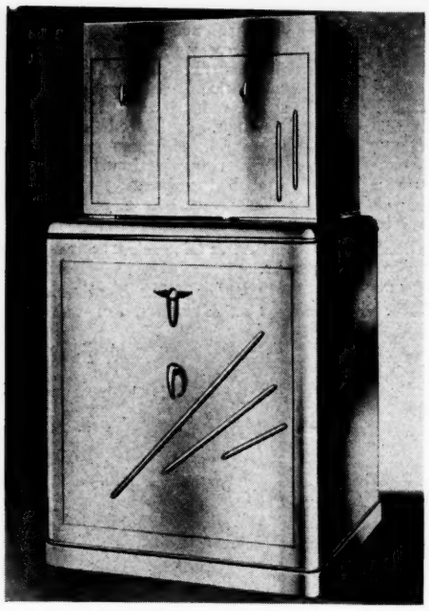


Janitrol Winter Air Conditioner

NAME AND MODEL NUMBER — Janitrol conditioner, types CF and CA.

PURPOSE—For winter air conditioning.

FEATURES—The CF model has a new cabinet which hides all supply lines. Two glass cooling filters, a humidifier, gas burner and heater surface are enclosed within the cabinet. See illustration. The burner is designed so that the gas burns with a short flame and shuts off quietly. Heat exchange is secured by a series of copper rods with a multiplicity of fins. The humidifier is of the refractory plate type with four large evaporating surfaces. The CA line of conditioners differs chiefly from the CF line in the heat exchangers and humidifiers. The heat exchangers, of which there are two, are of heavy steel plate with staggered baffles. Humidifier is of the pan type.



MADE BY—*Surface Combustion Corp., Toledo, Ohio.*

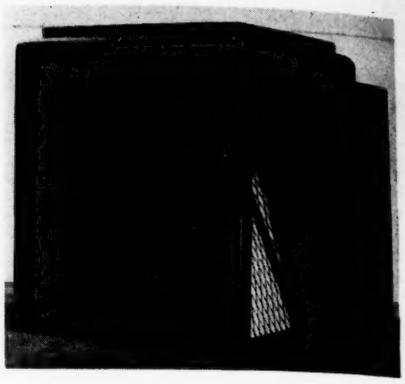
Bodine Mounting Base

NAME—Resilient mounting base.

PURPOSE—A resilient mounting base for fractional horsepower motors.

FEATURES—The motor is carried by live rubber in shear which is said to be a more efficient absorber of vibration than rubber in compression or tension. The manufacturer states that despite its high resilience, the mounting is unusually stable and that measurements show that a bending torque on the shaft changes the relative position of the motor frame but slightly.

MADE BY—*Bodine Electric Co., 2254 W. Ohio St., Chicago.*



Vik-Air DeLuxe Conditioner

NAME—Three-speed Vik-Air conditioner.

PURPOSE—For use with warm air furnaces to supply cleaned and forced air.

FEATURES—Three-speed operation, two lower speeds for winter use and high speed for summer circulation. Filters are so arranged that they may be used to filter the air from the basement during the summer and clean the air from upstairs in the winter. Self-adjusting motor base which is said to keep a constant tension on fan belt drive. Rubber mountings used on motor and blower to prevent the transmission of vibrations.

SIZES AND CAPACITIES—Five sizes ranging from 1,000 c.f.m. to 3,500 c.f.m. high speeds.

MADE BY—*Viking Air Conditioning Corp., 1935 Euclid Ave., Cleveland, Ohio.*

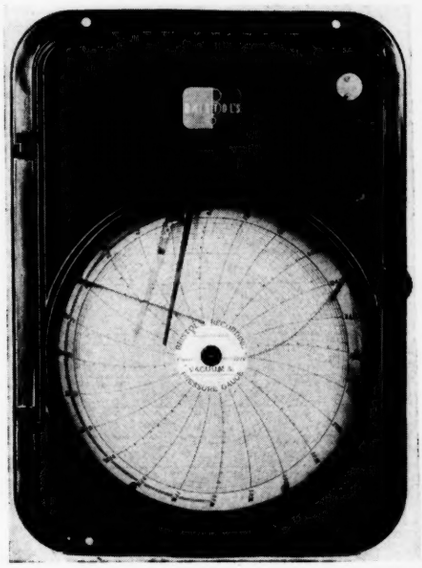
Bristol Pressure Recorders and Controllers

NAME AND MODEL NUMBER — Bristol low-range model D40M.

PURPOSE — For recording and controlling drafts or pressures in minimum ranges of 0 to 0.2 in. of water and maximum ranges of 0 to 2.0 in. of water.

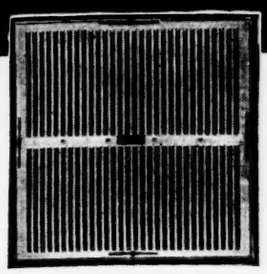
FEATURES—The control instruments operate on the basic Free Vane principle of pneumatic control used extensively on other items made by this company. Equipped with a sensitivity adjustment for synchronizing throttling range with process lag. Instruments are compact and self-contained in a 12-in. case and are offered for wall and flush panel mounting.

MADE BY—*The Bristol Co., Waterbury, Conn.*



AIR FILTER HEADQUARTERS

★ ★ ★ *Staynew Filter Corp.*
of ROCHESTER, NEW YORK

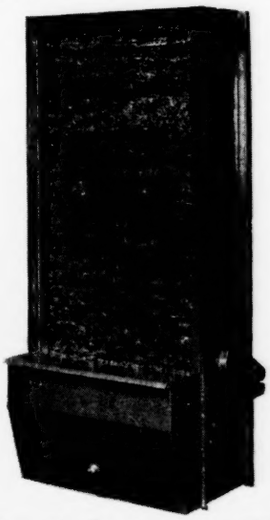


Panel Dry Type Filters.

20"x20" panels of 800 c.f.m. capacity. Can be bolted together to provide any required capacities. Feltex filtering medium in fin construction is 99.9% efficient. Easily cleaned, long-lasting filters for general ventilation and engine protection.

Multi-V-Type Dry Filters.

Patented, exclusive arrangement of V-shaped filter pockets of special cellulose filter medium in low-cost fiber frames. 98% efficient. Cleanable many times—inexpensively replaced. For general ventilation.



Automatic Impingement Filters.

Newest Protectomotor development. Dust and foreign matter in air stream impinge on intermittently revolving curtains which pass thru an oil bath. For general ventilation and engine protection where large volumes of air containing a high percentage of foreign matter must be handled most economically.

The big battle of business is on once more! New building and building renovation have started again with a rush. You are going to need air filters for more uses than ever before. Complete air conditioning includes filtering as one of the 5 requisites. Most offices in factory districts are installing air filters in new ventilation systems — homes, schools, offices and industrial plants are using air filters.

The complete Protectomotor line—more than 100 models, styles and sizes, exclusive of special design—includes an air or gas filter for every use in industry. Get the Staynew catalog for complete information on filters for every purpose.

OUTSTANDING FIRMS USE PROTECTOMOTORS

American Can Co.
American Museum of Natural History
Beech-Nut Packing Co.
Bethlehem Steel Co.
The Borden Company
Chrysler Corp.
Corning Glass Works
Crosley Radio Corp.
E. I. DuPont de Nemours & Co.
Eastman Kodak Co.
Ford Motor Company
Fisher Body Co.
General Foods Corp.
General Motors Corp.
Metropolitan Life Ins. Co.
New York Central R.R. Co.
Packard Motor Car Co.
Standard Oil Co. of N. J.

Hundreds of other careful buyers have placed many repeat orders.

PROTECTOMOTOR
REG U.S PAT OFF.
99 9/10 Per Cent EFFICIENT
AIR FILTERS

ALSO COMPLETE LINE OF FILTERS FOR ENGINE PROTECTION AND AIR AND GAS LINE FILTRATION.

STAYNEW FILTER CORP.
15 Leighton Ave., Rochester, N. Y.
Please send a copy of your catalog.
Name .....
Street .....
City ..... State .....

★ ★ ★

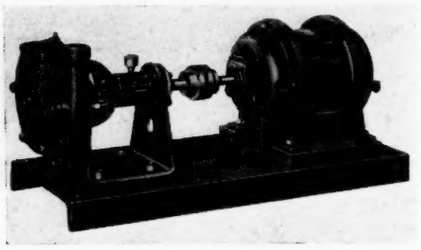
New Equipment

Worthington Centrifugal Pump

NAME—Worthington centrifugal pump.

PURPOSE—For pumping water.

FEATURES—The manufacturer says that the unit is a low cost, high quality centrifugal pump. Pumps are furnished with direct motor drives or with pulleys for belt drive. The



shaft is supported by two ball bearings enclosed in a dirtproof and moistureproof housing. Suction head is easily removed for inspection of the pump's interior. A choice of standard, all-iron, and all-bronze fittings is offered.

SIZE AND CAPACITY — From 10 to 130 g.p.m. with heads from 10 to 100 ft.

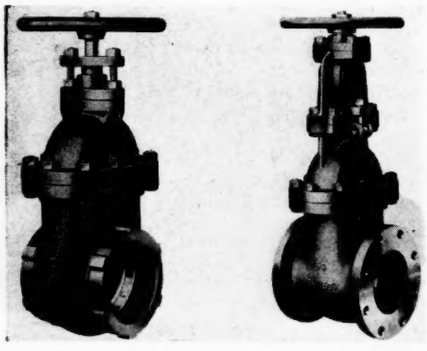
MADE BY—*Worthington Pump and Machinery Corp., Harrison, N. J.*

Kennedy Wedge Gate Valves

NAME—Kennedy wedge gate valves.

PURPOSE—Gate valves for steam working pressures up to 150 lb. and water working pressures up to 200 lb.

FEATURES — The manufacturer states that the metal in these valves is of a particularly dense structure and that it has proved to be more than 50% stronger than ordinary cast iron. Both non-rising stem and outside-screw-and-yoke types have special provisions to facilitate repacking. The stuffing box bolts and



nuts are rustproofed to prevent corrosion. Heavy bronze bushings are used wherever the stem passes through a cast iron part to prevent corrosion and scoring.

MADE BY—*The Kennedy Valve Manufacturing Co., Elmira, N. Y.*

Sarco Steam and Water Mixer

NAME—Sarco steam and water mixer.

PURPOSE—For producing hot water at any desired temperature by mixing steam and water.

FEATURE—Mixer incorporates a three-way valve, a water injector, and a temperature regulator in one compact unit. Nozzle type injectors are used to insure silent operation. Small sizes use single seated valves; large sizes, double seated. Available in capacities ranging from 80 to 1400 g.p.h. 100F rise with steam pressures from 25 to 150 lb.

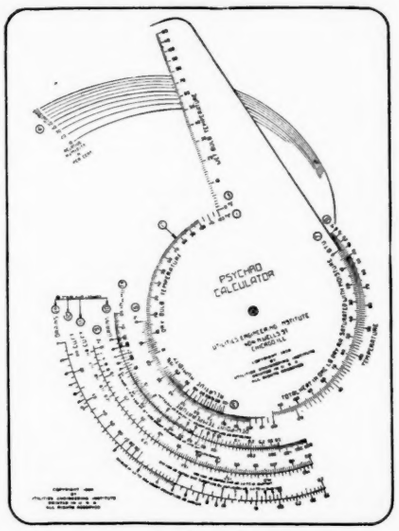
MADE BY — *Sarco Co., Inc., 183 Madison Ave., New York.*

Psychrometric Calculator

NAME—Utilities Engineering Institute's Psychro Calculator.

PURPOSE—A calculator to be used for determining psychrometric values and properties of air and water vapor mixtures. The manufacturer says that the Psychro Calculator makes it possible to obtain, by one setting of the movable indicator, any two of the four following items: dewpoint, dry bulb, wet bulb, and relative humidity, when the other two are known. The Psychro Calculator is also said to give such values as the weight of saturated vapor per pound of dry air, vapor pressure, weight of saturated vapor per cubic foot, total heat in B.t.u. per pound and difference in total heat of any two wet bulb temperatures. Values that may be read directly from dry bulb are volume in cubic feet of 1 lb. of dry air and volume of moisture to saturate 1 lb. of dry air.

FEATURES—Calculator is 7½ x 10½ in.



and has surface finish which can easily be cleaned.

MADE BY—*Utilities Engineering Institute, 404 N. Wells St., Chicago.*

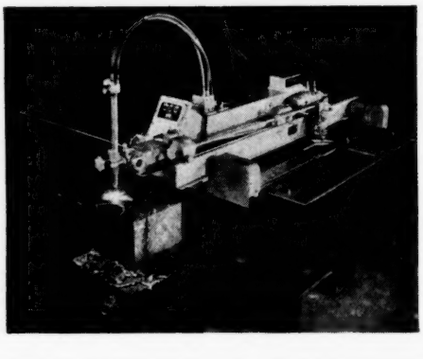
Linde Oxweld Cutting Machine

NAME AND MODEL NUMBER — Oxweld type CM-12 shape cutting machine.

PURPOSE—Flame cutting machine for cutting shapes of all descriptions out of metal, up to 12 in. thick and over.

FEATURES — The manufacturer states that any shape from the simplest to the most complicated can be accurately produced either automatically with templets or guided by hand. Cuts as long as 144 in. are said to be possible and they can be made at any desired angle in the horizontal plane. The apparatus can also be used for multiple cutting as it is designed to carry from 2 to 5 blowpipes.

MADE BY—*The Linde Air Products Co., 205 East 42 St., New York.*

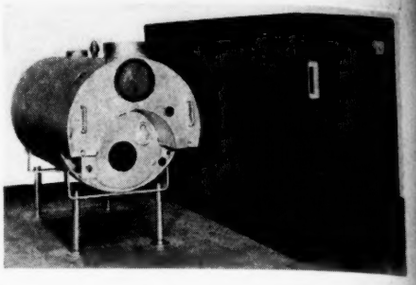


Titusville Ti-Scot Heating Boilers

NAME—Ti-Scot scotch marine, oil burning, tubular, steel heating boilers.

PURPOSE—For supplying steam or hot water using oil as a fuel.

FEATURES—The boiler is a low water line



marine type boiler built for oil burning. Manufacturer claims a high efficiency due to large furnace volume and two-pass long gas travel area. It is built of copper bearing steel, electrically welded and tested to 130 lb. Either tank or tankless type water heater with submerged copper coils can be supplied with boiler. Standard equipment includes jacket, supporting legs, water column, water gage, gage cocks, safety valve, steam gage, flue brush and Draft-O-Stat. Refractory material is installed in factory.

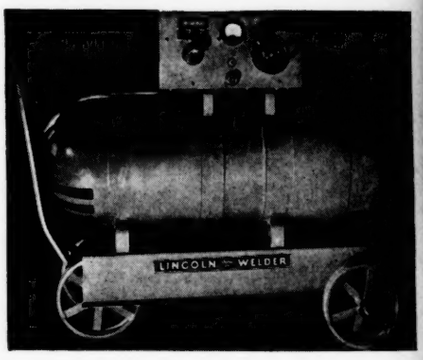
SIZES AND CAPACITIES—10 sizes ranging from 612 to 2,680 sq. ft. steam radiator surface.

MADE BY—*The Titusville Iron Works Co., Titusville, Pa.*

Lincoln Shield Arc Welder

NAME AND MODEL NUMBER—Shield arc SAE welder.

PURPOSE—Welding.

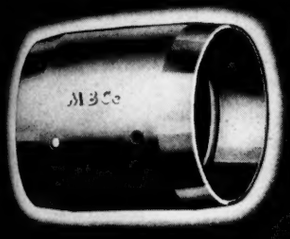


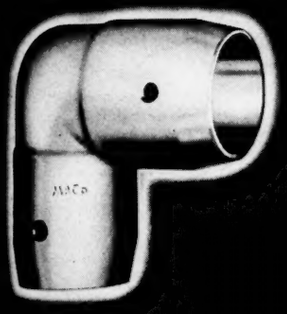
FEATURES — The predominating feature of this arc welder is a new method of arc control which makes possible the adjustment of both arc heat and arc penetration in a continuous sequence of fine increments. It is claimed that this continuous dual control assures uniformity of performance at every control setting and adds to the successful operation of arc welding. This new welder will supersede the present type of shield arc and is said to retain all of the important design points of the older device.

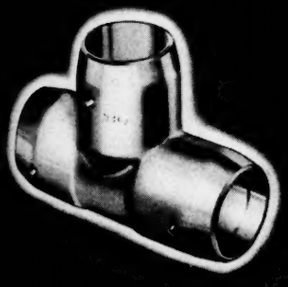
SIZES AND CAPACITIES—A.c. motor-driven —200, 300, 400, and 600 amp.; d.c. motor-driven—300, 400, and 600 amp.; generator for belt or couple service—200, 300, 400, and 600 amp.; engine-driven—200, 300, and 400 amp.

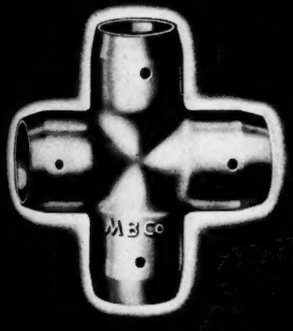
MADE BY—*The Lincoln Electric Co., Cleveland, Ohio.*

STREAMLINE
COPPER PIPE AND FITTINGS









THE PERMANENT, ULTRA-MODERN PIPING SYSTEM FOR PLUMBING, HEATING *and* AIR CONDITIONING

STREAMLINE Fittings and Copper Pipe are being successfully used today in hundreds of industrial applications such as stock and paper lines in paper mills, water, wert, beer and "attemperator" piping, breweries, vinegar and fruit juice lines, compressed air lines, in electric refrigeration work, gas, oil, and vacuum lines or for the handling of liquids of low specific gravity such as gasoline, butane, etc. which readily seep through threaded connections. They are in widespread use for all lines in hot water heating for low pressure mains, risers, branches and returns in steam heating systems. STREAMLINE Copper Pipe and Fittings are now installed on 36 major railroads for air conditioning purposes.

An installation of STREAMLINE Copper Pipe and Fittings cannot rust; its joints are permanently leak-proof; continuous vibration cannot work them loose and in contrast to threaded connections, the joint is the strongest point in the line.

Use STREAMLINE on your next piping job and get the service and savings which its strength and resistance to corrosion provides.

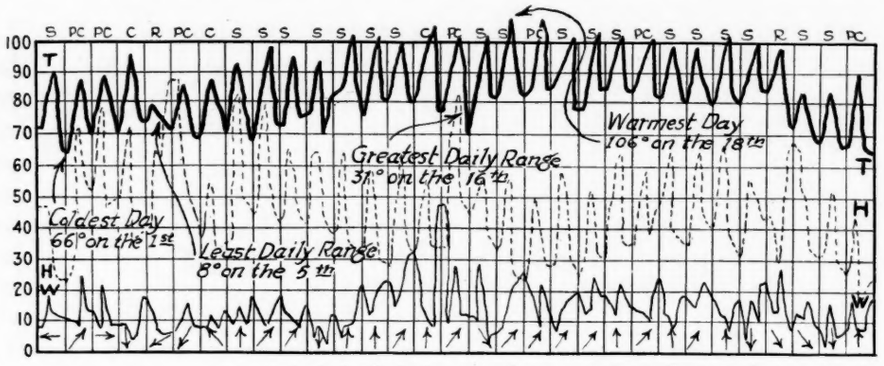
STREAMLINE FITTINGS ARE FURNISHED IN SIZES FROM 1/4" to 12" INCLUSIVE WITH A FULL RANGE OF REDUCING SIZES. STREAMLINE COPPER PIPE IS FURNISHED IN GOVERNMENT TYPES K, L AND M IN BOTH HARD AND SOFT TEMPERS.

Send for Catalog F

STREAMLINE PIPE AND FITTINGS CO.
PORT HURON, MICHIGAN
DIVISION OF MUELLER BRASS CO.

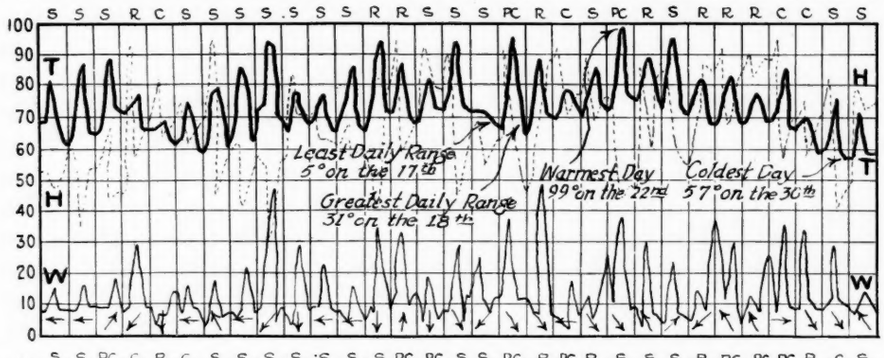
THE WEATHER FOR AUGUST, 1936

Plotted from records compiled for HEATING & VENTILATING by the U. S. Weather Bureau. Heavy curves (T), dry bulb temperatures in deg. F.; dotted lines (H), per cent relative humidity from readings at 8 a.m., noon, and 8 p.m. Light lines (W), wind velocity in m.p.h. Arrows indicate prevailing wind directions, north being arrow pointing up, etc.; S—clear; PC—partly cloudy; C—cloudy; R—rain; Sn—snow.



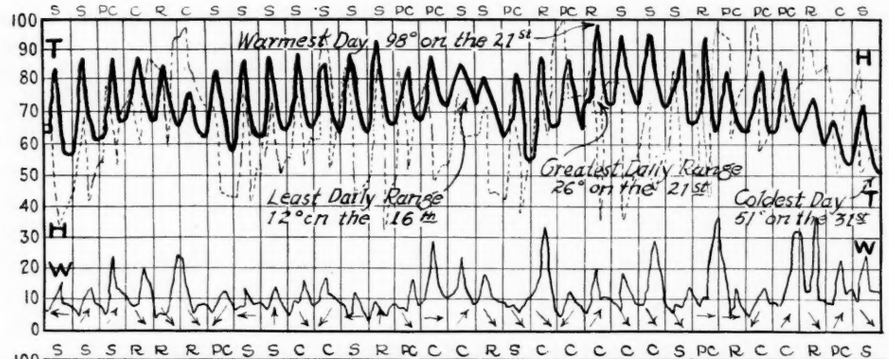
St. Louis

Mean temp. for month, 85.6F; aver. wind velocity, 11.6 m.p.h.; prevailing direction of wind, SW.



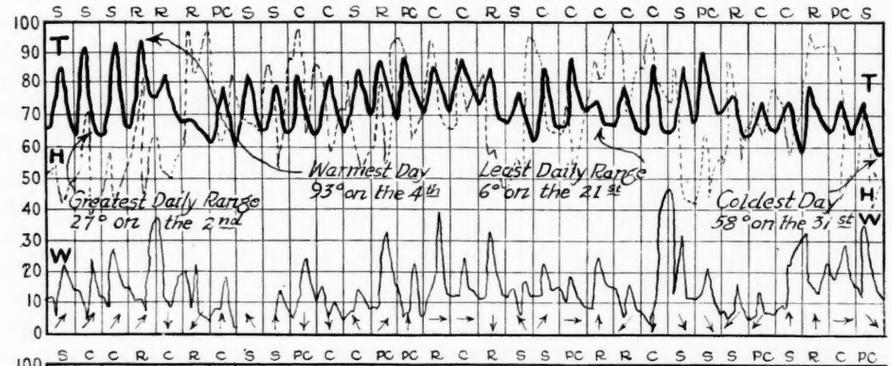
Chicago

Mean temp. for month, 75.3F; aver. wind velocity, 9.2 m.p.h.; prevailing direction of wind, S.



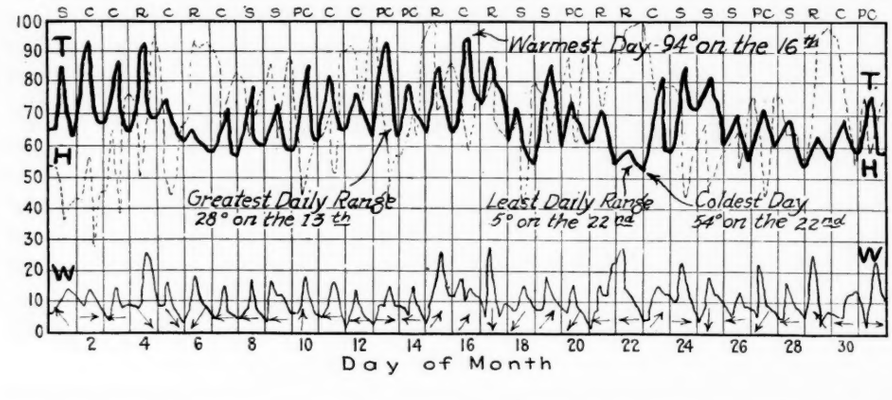
Pittsburgh

Mean temp. for month, 74.6F; aver. wind velocity, 9.1 m.p.h.; prevailing direction of wind, SW.



New York

Mean temp. for month, 74.1F; aver. wind velocity, 12.0 m.p.h.; prevailing direction of wind, SW.


Warmest Day 94° on the 16th
Greatest Daily Range 28° on the 13th
Least Daily Range 5° on the 22nd
Coldest Day 54° on the 22nd
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Day of Month

Boston

Mean temp. for month, 69.7F; aver. wind velocity, 8.7 m.p.h.; prevailing direction of wind, E.

AN EXCLUSIVE

Streamlined

HEATING SURFACE

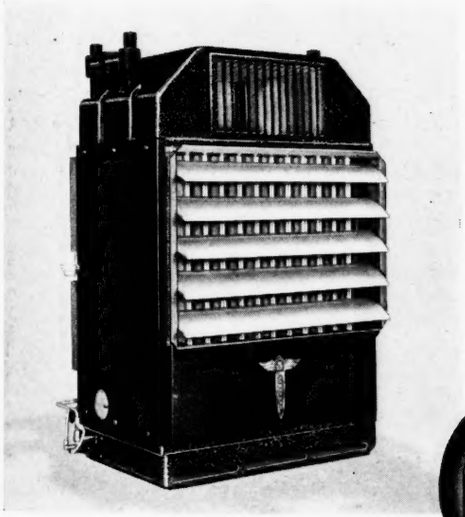
In Janitrol Gas Unit Heaters provides instant . . . constant economical heat . . . when and where you want it . . .

Wider streamlined heating units are an exclusive feature in Janitrol Unit Heaters. Forced air flowing over this wider surface keeps in longer contact with the heating unit, and so heats more quickly and without waste. The streamlined surface also lowers air resistance, and reduces fan power consumption.

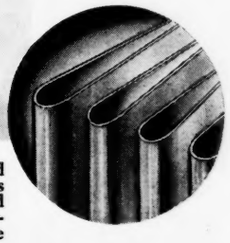
Each Janitrol Unit is a self-contained heating plant—independent of boilers, radiators or furnace—or engineers or firemen to attend it. With a Janitrol Gas Unit Heater you set it and forget it because its *fully automatic!*

Investigate Janitrol. Call your Gas Company, or write the

SURFACE COMBUSTION CORPORATION, TOLEDO



U-200-36 model is designed for heating large areas, such as assembly halls, dance halls, factories, warehouses, air-plane hangars, garages, etc. It has an hourly input of 200,000 B.T.U.

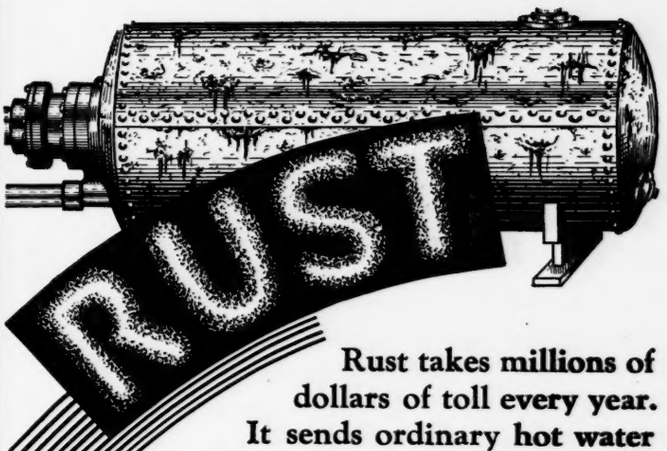


Fan-sped air flows over and around the wide streamlined units, is heated thoroughly and distributed evenly. Approved by the Underwriters Laboratories, and the American Gas Association.

SC

JANITROL

UNIT HEATERS



Rust takes millions of dollars of toll every year. It sends ordinary hot water storage heaters to the junk pile. It stains clothes and causes red bath water.

Do you want your clients to put up with this menace when rust and red water can be done away with forever by installing a

Patterson

Everdur or Copper-Lined Hot Water Heater

Having a shell of 96% pure copper, Patterson Everdur Heaters are not only rust-proof, but possess the tensile strength of steel.

Patterson Indestructo Heaters have a heavy copper shell inside of the rugged steel shell, so there is nothing to rust.

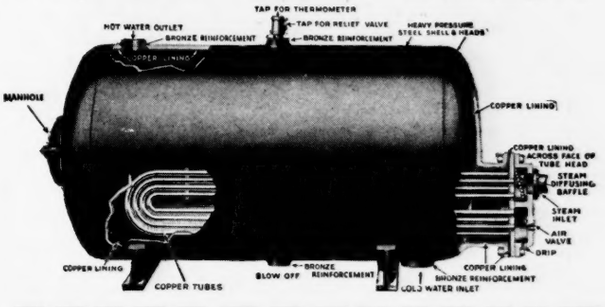
The rugged, long-lived and reliable performance of Patterson Hot Water Heaters reflects the great care and enduring quality that over a half century of experience has taught us how to build into them.

Patterson Heaters are also made with shells of pure copper, stainless steel, nickel clad steel and steel.

Write for catalog or mail the coupon.

The Patterson-Kelley Co.

105 Burson St. East Stroudsburg, Pa.



The Patterson-Kelley Co.,
105 Burson St., East Stroudsburg, Pa.

Without obligation on our part, please send your catalog on:

☐ Everdur Heaters ☐ Copper-Lined Heaters
☐ Steel Shell Heaters ☐ Have your engineer call

Name.....

Address.....

City.....State.....

Standardization does not stop with the attractive, warmly colored terra cotta tile front and uniform architectural style of all stores of S. H. Kress & Co. For Sarco Heating Specialties have also been the Kress standard for many years.

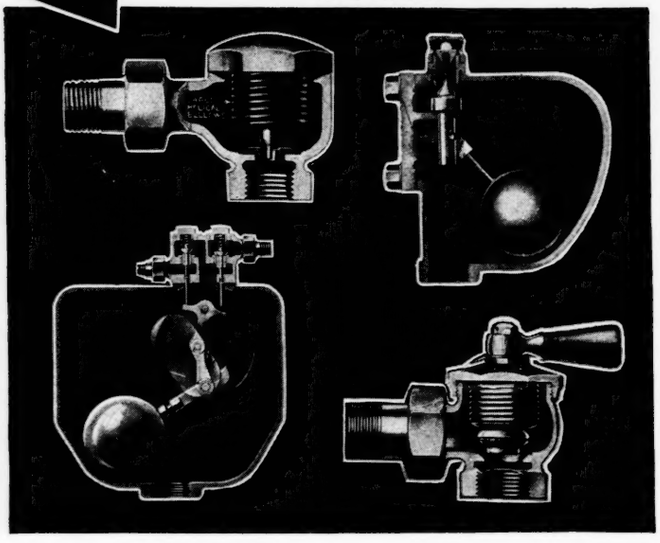
A product must be good when shrewd buyers like these continue to buy it year after year as new stores are erected.

Sarco have been making steam specialties for a quarter of a century and should know how to build a good heating system.

It may be to your advantage to learn more about the Sarco. Why not write for Catalog P-45.

SEE OUR EXHIBIT AT BOOTH NO. 81
Twelfth National Exposition of Power & Mechanical Engineering, Grand Central Palace, New York, Nov. 30 to Dec. 5, 1936.

SARCO COMPANY, Inc.
183 MADISON AVE. NEW YORK, N. Y.
BRANCHES IN PRINCIPAL CITIES
SARCO CANADA LTD., FEDERAL BLDG., TORONTO, ONT., CANADA



NEW CATALOGS

American Radiator Co., 40 W. 40 St., New York, has published a standard-size manual on Arco wrought copper fittings and copper pipe. The manual has been compiled so that architects, engineers, wholesalers, and contractors may be acquainted with the company's copper products, their uses and method of installations. Complete illustrated instructions are given for installing this type of equipment for both heating and plumbing work. Engineering information on the properties of Arco copper pipe is included. Also included are data on capacities and heat emissions of copper pipe. The manual has 36 pages.

Consolidated Air Conditioning Corp., 114 E. 32 St., New York, has published a booklet entitled "Consolidated Odor Absorbers in Air Conditioning." This book takes up the question of cost of operating air conditioning systems and the necessity of reducing the amount of make-up air. A set of tables showing the savings effected by reducing the make-up air is included.

Dail Steel Products Co., Lansing, Mich., has published a standard-size, 16-page catalog on the Dailaire system of heating, cooling and air conditioning. The bulletin gives specifications covering the equipment offered by this company.

Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago. A standard-size, 64-page fan and blower catalog FB-45. This booklet covers all of the fans and blowers which Ilg offers. In the beginning of the book are instructions for selecting and installing the various types of Ilg equipment.

The Korfund Co., Inc., 48-15 Thirty-Second Place, Long Island City, N. Y., has published a general catalog on anti-vibration products. Included in the bulletin are discussions of the elementary considerations of vibration control, cork as a natural isolating medium, vibration isolation by means of steel springs and special vibro dampers.

H. A. Thrush & Co., Peru, Ind., has published an elaborate wall poster advertising the Thrush control system of hot water heating. This poster is approximately 22 x 34 in. in size and is printed in four colors. It includes a picture showing how the Thrush devices are connected on a hot water system.

The Whitlock Coil Pipe Co., Hartford, Conn., has published three data sheets on heat transfer practice. The first sheet deals with steel shell thicknesses for storage type water heaters, the second with capacities of standard steel pipe in pounds of water per hour, and the third with capacities of standard steel pipe in pounds of steam per hour. These data sheets are standard size and are presented in a bright red folder of special heavy paper.

WITH THE MANUFACTURERS

Anthracite Industries, Inc., New York, has appointed **Daniel A. Zupa, Charles T. Heslin, and Gladys F. Rohling** to its staff. Mr. Zupa and Mr. Heslin join the sales group. Mr. Zupa, an engineer, was formerly New York manager for Reading Iron Co. Mr. Heslin was formerly with Electric Furnace Man, Inc.

Miss Rohling, who will assist in advertising and publicity, previously was advertising manager for the Westchester Service Corp.

Robert Barclay, Inc., 122 North Peoria St., Chicago, wholesale distributor of automatic heating accessories, has elected **Milton K. Arenberg**, president. Mr. Arenberg recently resigned as Chicago district manager of Ilg Electric Ventilating Co., with whom he had been associated for the past 20 years.

The Bristol Co., Waterbury, Conn., has appointed four engineers to its field service organization — **E. H. Hart,** assigned to the Boston office; **J. N. Swarr,** New York office; **K. J. Platt** to Philadelphia; **R. A. Barnes,** to St. Louis.

Carrier Corp., Newark, N. J., announced the discontinuance and liquidation of its three former subsidiaries: Carrier Engineering Corp., Carrier-Brunswick International, Inc., Carrier Engineering Corporation of California. All business formerly conducted under the names of the subsidiaries will hereafter be done directly by Carrier Corp., which now becomes an operating company.

Crane Co., Chicago, Ill., has consolidated under a single department all general office selling activities on its plumbing and heating products, which will result in close coordination in the sale of plumbing, heating, water systems, water heaters, softeners, and other products sold through heating and plumbing contractors. The ultimate objective is to provide all types of buildings completely with the company's products.

The new sales department will be headed by **George E. Hoffman,** manager, and **Neil D. Skinner,** assistant manager. The three sections of the department will each have its own manager, as follows: plumbing, **J. A. Farley;** heating, **Lynn G. Lindsay;** pumps, **W. J. Pick.**

G. E. Hoffman

N. D. Skinner

Mr. Hoffman, in addition to his duties in the new department, is vice-president and general sales manager of the subsidiary, Trenton Potteries Co., and general manager of sales of Crane Enamelware Co., Chattanooga, Tenn.

The company has also appointed **Erie Concrete & Steel Supply Co.**, Erie, Pa., as distributor of its products in northwestern Pennsylvania.

S. S. Fretz, Jr., Inc., General Electric air conditioning dealer, has moved its offices from 2514 N. Broad St., Philadelphia, to **1902 Chestnut St.,** same city.

Gar Wood Industries, Inc., Detroit, Mich., has appointed **Arthur C. Bader** in charge of all architectural activities in the Detroit metropolitan area.

Goetze Gasket & Packing Co., Inc., New Brunswick, N. J., has completed another addition to its plant, making the fourth addition since 1928. Former capacity has been practically doubled by the added space and new equipment, developed by its own engineers, installed.

Johns-Manville, New York, has appointed **J. F. Stone** staff manager of the refrigeration section of its insulation department. Mr. Stone was formerly assistant manager of this department.

Kelvinator Corp., Detroit, Mich., has completed plans for a $600,000 plant expansion program which will include the construction of two buildings with a total floor space of 304,000 sq. ft. This will permit a 25% increase in capacity.

Leeds & Northrup Co., Philadelphia, Pa., has opened a New England office at 422 Chamber of Commerce Building, 80 Federal St., Boston, Mass.

Moeller Instrument Co., 261-5 Sumpter St., Brooklyn, N. Y., has increased its manufacturing floor space through the purchase of a modern factory on the south side of 132nd St. and 89th Ave., Richmond Hill, New York.

The Ohio Electric Mfg. Co., Cleveland, Ohio, has appointed **George W. Duncan** assistant motor sales manager. Mr. Duncan for the past 16 years was connected with the fractional motor department of General Electric, Fort Wayne, Ind.

D. M. Fraser, Ltd., Toronto, Ont., has been appointed motor sales representative for Canada. **H. Vearncombe** will be associated with Mr. Fraser.

BVD's for BTU's?

WHAT—no asbestos suits for these beauties? No, we don't sell much Ric-wiL in the South Seas. For the famed Virgins of Bali, for the delectable damsels of Tahiti, protective covering is not needed. In fact, to obscure such *lines* as these would be a mistake.

It's another story with *steam lines* underground. Here protection is an absolute necessity. But unless you have insulation that *insulates*, and drainage that *drains*, unless you have *sealed-in* steam—your steam lines might almost as well "go nudist." You can't make B V D's take the place of ulsters. This year, as every year, correctly dressed steam lines are wearing Ric-wiL—for instance, SEVEN large Government Housing Projects are using Ric-wiL exclusively.

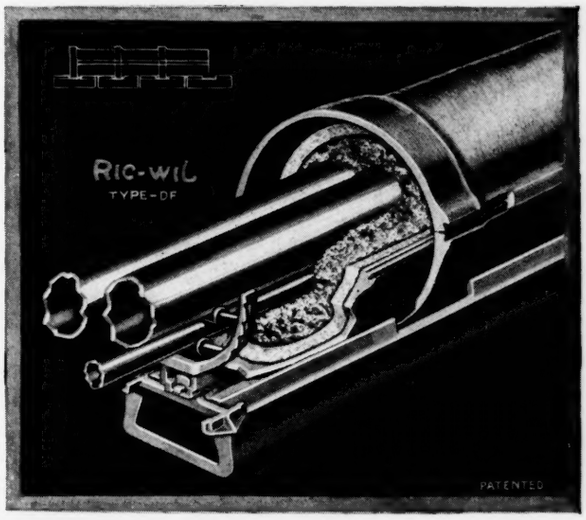
26 years' experience gives the Ric-wiL Organization an invaluable advantage. Ric-wiL Systems are correctly engineered and drained—they keep steam lines tight, dry and over 90% efficient. Designs and materials in both tile and cast iron to meet all possible conditions. Obtainable with various insulations, including the famous Ric-wiL Watertight Asbestos Dry-paC. Ric-wiL service is complete from coast to coast—installation, engineering, field supervision. Write for complete catalog, with Dry-paC sample for testing.

The RIC-WIL Co., Union Trust Bldg., Cleveland, Ohio

New York **San Francisco** **Chicago**

Agents in principal cities

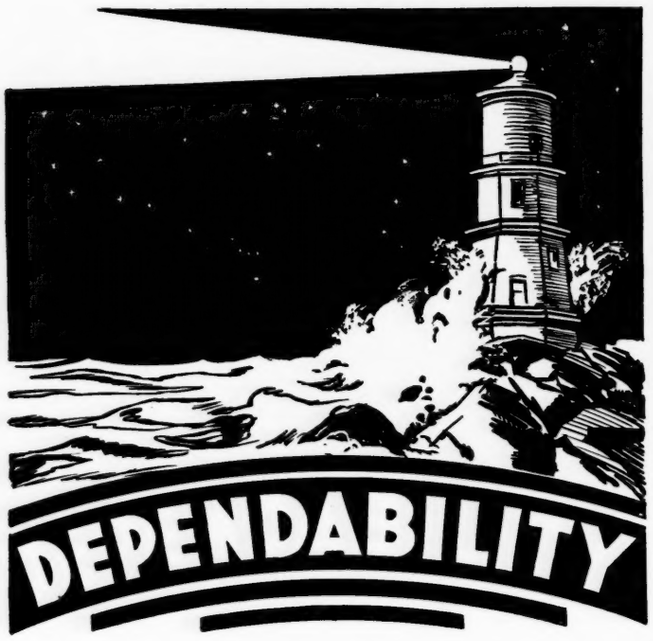
According to competent authorities, heat loss from conduit in wet soil is over four times that in dry soil. Ric-wiL External Underdrain keeps the soil DRY.



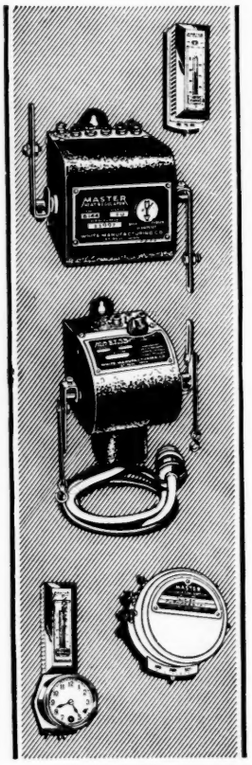
REGISTERED IN U. S. PATENT OFFICE

RIC-WIL

CONDUIT SYSTEMS FOR UNDERGROUND STEAM PIPES



Human lives would often be lost were it not for the dependability of this faithful beacon that flashes its warning signal exactly on the second every night of every year.



Master Heat Regulators are Dependable, too

For twenty years dependability of performance has been built right into the Master line. Architects, contractors, dealers and users can place their implicit faith in it.

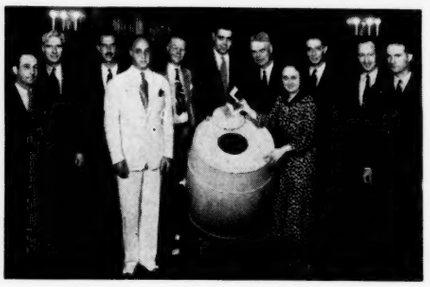
Type B 22
Dealers' Cost $13.50

A low cost, two-position heat regulator for owners of small homes, responsive to temperature changes of 1 degree. Only the best materials are used in its manufacture. It will render perfect service for many years and will actually outlast the heating plant. Listed as standard by the Underwriters' Laboratories.

WHITE MANUFACTURING COMPANY
2364 University Ave., St. Paul, Minn.
MAKERS OF THE FAMOUS TYPE B-144, THE ORIGINAL GRADUAL CONTROL HEAT REGULATOR

MASTER HEAT REGULATOR

Penn Electric Switch Co., Des Moines, Ia., in connection with its 1936 Temtrol meetings, recently concluded, named the three following as winners of the grand prize awards: First prizewinner: **Fred T. Hyde,** installation man, Borstein Electric Co., oil burner dealer, Camden, N. J.; second prizewinner: **Frank Schutze,** stoker distributor, Peoria, Ill.; third prizewinner, **Myron Rogatka,** salesman, Calkins Heating Co.., oil burner dealer, Buffalo, N. Y. Penn Temtrol meetings this year were held in 55 cities.



Penn Temtrol award committee: (Left to right) George G. Turner, Charles Ott, Ben J. Parsons, Craig Espy, G. R. Wilson, E. G. Hutchison, Charles E. Price, Nelson B. Delavan, K. W. Cash.

Pioneer Utilities Corp., Div. Preferred Oil Co., Inc., 95 Frost St., Brooklyn, N. Y., distributors of Scott-Newcomb Pioneer oil heating systems in the boroughs of Brooklyn and Queens, New York, has now extended its operations into Manhattan, Bronx, and Staten Island. A Bronx office is maintained at 1059 Gun Hill Road.

Republic Steel Corp., Cleveland, has appointed **Frank J. Laskey** general purchasing agent. **Robert E. Sherratt** has been named assistant general purchasing agent.

Reynolds Molded Plastics, Division of Reynolds Spring Co., Jackson, Mich., has opened a New York sales office at 90 West St. in charge of **Herbert S. Reynolds, Jr.** Mr. Reynolds was formerly connected with the factory at Jackson.

Signal Electric Mfg. Co., Menominee, Mich., will build a two-story addition to its plant. The new addition will be 79 ft. long and 56 ft. wide.

H. J. Somers, Inc., Detroit, Mich., has moved its factory from 1984 W. Lafayette Blvd. to a larger remodeled building at **6063 Wabash Ave.**

Spencer Thermostat Co., 34 Forest St., Attleboro, Mass., has appointed **N. A. Naylor** manager of its new branch office in Cleveland. He was formerly eastern sales manager of the General Controls Co. Mr. Naylor, formerly of San Francisco, is a graduate engineer of the University of California, and has spent most of his time in the heating and automatic temperature control field.

N. A. Naylor

H. A. Thrush & Co., Peru, Ind., has transferred **William K. Hoyt** from its Baltimore to New York branch. Mr. Hoyt will assist **Charles W. Norby,** New York branch manager. **Frank C. Bond** has been added to the personnel of the New York branch to cover upper eastern New York and Connecticut. **J. Raymond Spencer** has been transferred from New York to Boston to assist **R. E. Lund,** Boston district manager on sales promotion and service work. **Russell E. Clegg** has been appointed direct factory representative in the greater Baltimore area.

ABSTRACTS

(Continued from page 66)

Technical Drawing Problems

This is a companion volume to the book entitled "Technical Drawing" which was reviewed in this section last month. This book is made up of a number of work sheets

which conform in size to the American Standard sheet. These sheets are designed so that the student can remove them and work out the problems, with the sheet fastened to a drawing pad. Among the subjects covered by the work sheets are the use of instruments, geometric constructions, lettering, isometric drawing, oblique drawing and dimensioning.

[*"Practical Drawing Problems," by E. Giesecke, A. Mitchell and Henry Spencer. Published by The Macmillan Co., 60 Fifth Ave., New York. Heavy paper cover, 9x11, 93 work sheets, price $1.40*].

●

Scale Prevention in Boilers

Engineers are continuously facing the problem of scale prevention in steam boilers and in attempting to prevent the formation of scale it is essential that they have data from which to select the particular treatment required. The purpose of the investigation was to study methods of chemical treatment which might be used for the prevention of the various types of scale which form in steam boilers.

Since the chemical treatment of boiler water may be readily classified under two distinct headings, inorganic and organic, it was thought advisable to divide this study into two parts.

The first part describes the results obtained in scale prevention by the use of various inorganic salts; the second part describes the results obtained by the use of various organic materials, such as the so-called tannin extracts.

The tests were run in a bomb apparatus, and in a small laboratory boiler arranged so that the conditions of the tests could be varied as desired. The tests indicated that both inorganic and organic materials could be used successfully to hold the scale-forming materials in solution in the boiler water, and thus prevent the formation of scale.

[*"A Study of the Reactions of Various Inorganic and Organic Salts in Preventing Scale in Steam Boilers," by Frederick G. Straub. Published by the Engineering Experiment Station, University of Illinois, Urbana, Ill. Bulletin No. 283. Heavy paper binding; 6 x 9 in.; 118 pages; price, $1.*]

COMING EVENTS

OCTOBER 20-23, 1936. 65TH ANNUAL MEETING, THE AMERICAN PUBLIC HEALTH ASSOCIATION, *New Orleans, La. Headquarters at the Municipal Auditorium.*

OCTOBER 26-30, 1936. 18TH ANNUAL CONVENTION OF AMERICAN GAS ASSOCIATION, *Atlantic City, N. J. Exhibition, Association of Gas Appliance Equipment Manufacturers, Municipal Auditorium, Atlantic City, N. J.*

NOVEMBER 11-13, 1936. THIRD ANNUAL CONVENTION OF THE REFRIGERATION SERVICE ENGINEERS' SOCIETY, *Hotel Gayoso, Memphis, Tenn.*

NOVEMBER 30-DECEMBER 4, 1936. FIFTY-THIRD ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, *Engineering Societies Bldg., New York.*

NOVEMBER 30-DECEMBER 5, 1936. 12TH NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING, *Grand Central Palace, New York.*

DECEMBER 2-4, 1936. 32ND ANNUAL CONVENTION OF THE AMERICAN SOCIETY OF REFRIGERATING ENGINEERS, *New York.*

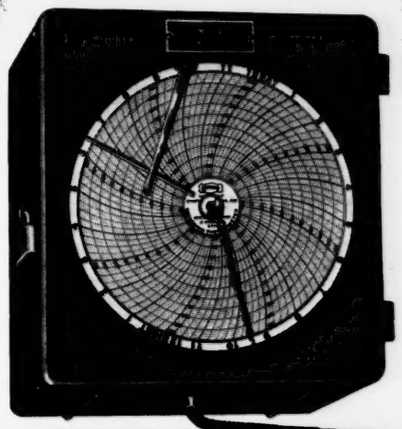
DECEMBER 10-11, 1936. 12TH ANNUAL CONFERENCE ON WELDING, *Purdue University, Lafayette, Ind.*

DECEMBER 15-17, 1936. WINTER MEETING OF THE NATIONAL WARM AIR HEATING AND AIR CONDITIONING ASSOCIATION, *Stevens Hotel, Chicago, Ill.*

JANUARY 25-27, 1937. 43RD ANNUAL MEETING OF THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, *St. Louis, Mo.*

MOTOCO

INDUSTRIAL THERMOMETERS



RECORDING THERMOMETER
MODEL 500
$31.00
LIST PRICE

DIAL INDICATING THERMOMETER
MODEL F1
$20.00
LIST PRICE

MOTOCO Instruments are designed to operate on any type of equipment requiring accurate, dependable temperature indication. They are manufactured with flexible capillary tubing for distance temperature indication or rigid stems for direct mounting. Each instrument is custom made, assuring you of most satisfactory operation on your equipment.

The MOTOCO Solid Liquid Filled movement is of exclusive design. Delicate hair springs, gears, pinions, etc., have been eliminated thus resulting in a sturdy one to one ratio movement which will give long life service under the most severe operating conditions.

A postcard or letter request will bring you details of the MOTOCO line.

MOTOMETER

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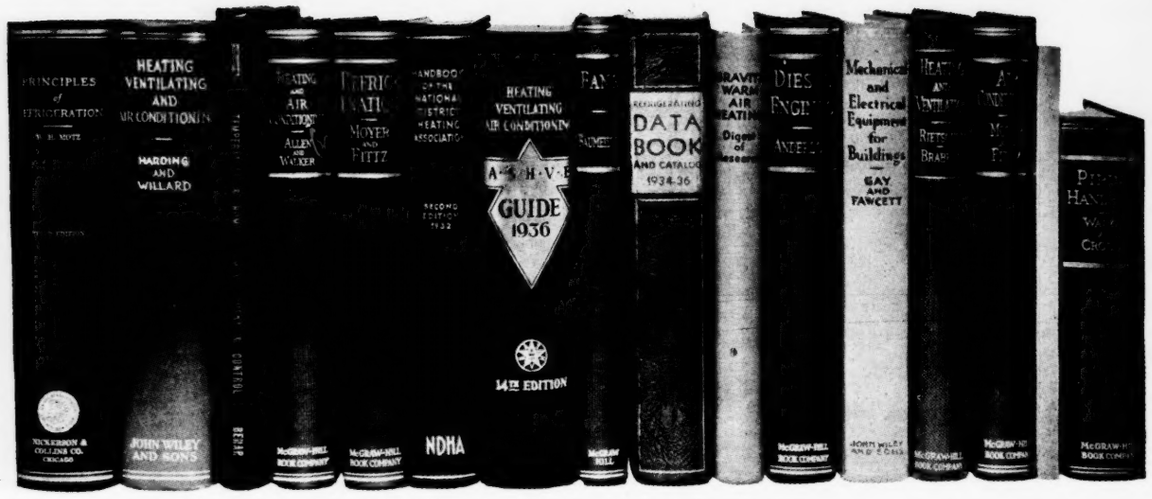

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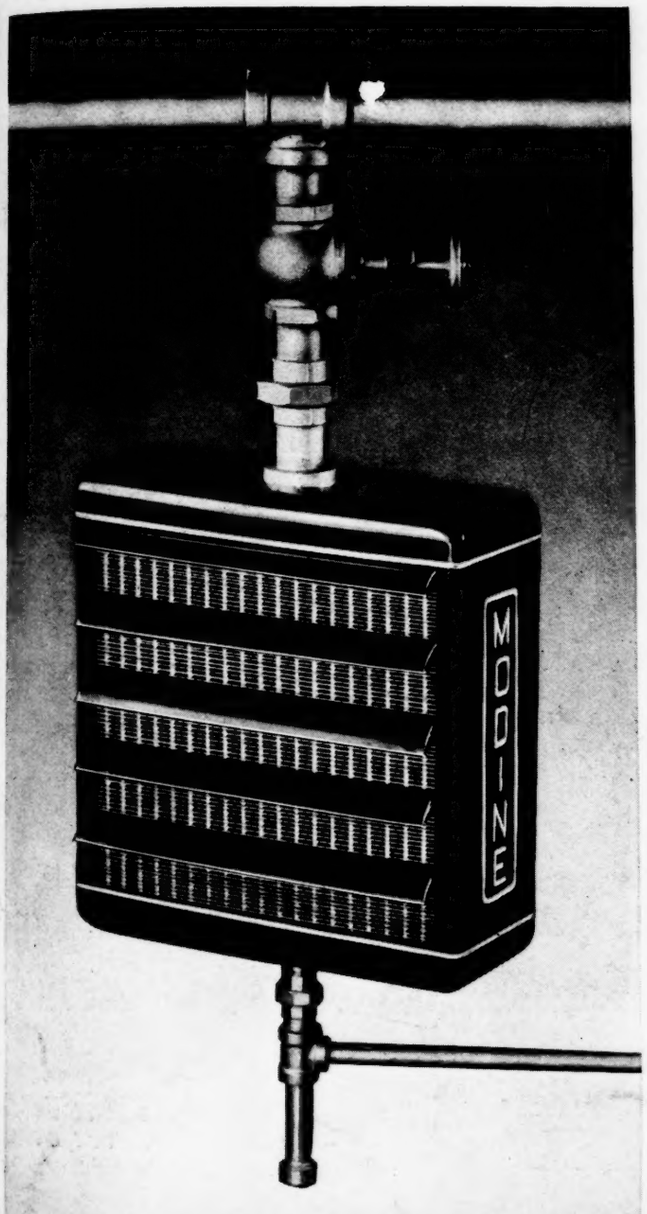

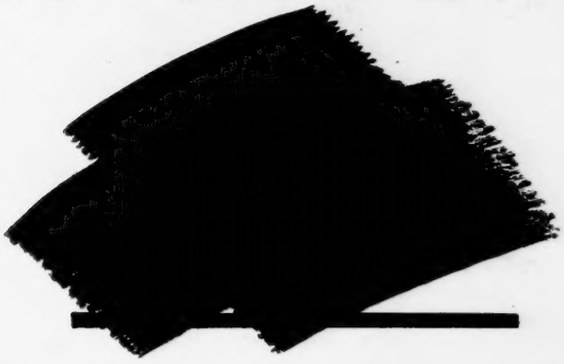

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